# OTONABEE REGION CONSERVATION REPORT

## LAND



ONTARIO DEPARTMENT OF COMMERCE AND DEVELOPMENT

CONSERVATION BRANCH

# OTONABEE REGION

## CONSERVATION REPORT

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## LAND

1961

## AUTHORSHIP

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## RECOMMENDATIONS

## STATED OR IMPLIED IN THIS REPORT

1. It is recommended that the Authority give close study to the policies of the Federal Government towards development of low-grade lands as expressed in their Agricultural and Rehabilitation Development Act (ARDA), details of which have yet to be announced.

2. Demonstrations of various land improvement practices such as reforestation, gully control, pasture renovation and improvement, drainage, farm ponds and grass waterways. These can be carried out in several ways:-

   (a) On Authority Conservation Areas, and combined with recreational use of the land.

   (b) On property purchased mainly for demonstration use.

   (c) On privately-owned land. The Authority can give assistance for carrying out specific conservation practices on their own land. For example, the Authority might give a farmer some assistance in an erosion control problem in return for the right to use the project as a demonstration.

3. Limited financial assistance, either for specific projects or as a general policy for certain types of approved conservation work, i.e., grassed waterways, farm ponds.

4. Assist in sponsoring land-judging competitions in the county in co-operation with the Department of Agriculture.

5. Combine the advisory functions of land use and reforestation under one Advisory Board.

6. Co-operate extensively with existing organizations such as the Federation of Agriculture, Farmers' Union, Junior Farmers, 4-H Clubs, Soil and Crop Improvement Association, Women's Institutes and other groups to advance the cause of conservation and good soil management.

# CHAPTER 1

## THE CONSERVATION PROBLEM

### 1. Land Use and Conservation

Conservation has been defined as the wise use of our natural resources. Wise use, however, is a rather incomplete definition. To some people it means hoarding for the future; to others it may mean getting the maximum present returns from these resources.

"The greatest use by the greatest number of people over the greatest period of time" is a definition that expresses thought for the future as well as present use and benefit to man.

Conservation cannot be resource hoarding, nor necessarily the single use of a resource, particularly when applied to land. If the productivity of the soil is being maintained or increased and, at the same time the landowner is receiving a good return for his work and investment, good land use and conservation are synonymous.

Land is valuable to us only as it contributes to human welfare. All our activities need land. We need land to provide food and fibre, to build homes and industries, to lay out transportation routes and facilities, to produce minerals and forest products and for recreation and aesthetic enjoyment.

Some land has qualities that make it suitable for many uses while other areas have only limited use; most land has several possible uses. The value of land normally increases in direct proportion to its number of possible uses, and the demand for its use for various purposes.

In rapidly growing Ontario, the demands for land in many sections are increasing. Frequently it is the best agricultural land that is in most demand for other purposes. When some of the good agricultural land is taken for other purposes, it increases the need to conserve and improve land

elsewhere that will remain agricultural. This is particularly true when such land has a lower agricultural capability.

The best use of land resources involves decisions by both private landowners, and by public bodies and government.

Landowners make decisions about the use of their own land. Farmers must decide on rotations, kinds of crops and fertilizer requirements. Sometimes a decision must be made whether to use land for agriculture at all, or whether it should be reforested, or sold for urban and industrial uses. Such decisions are usually dictated, or influenced, at least in part by economic considerations.

Many decisions regarding the use of land as a result of competing demands on it are made by public bodies - municipal councils and planning boards, and Provincial and Federal Governments. Such decisions are made (1) by official plans, and zoning by-laws (2) by purchase for provincial, national and municipal parks, highways, airfields and other purposes. Government and agency actions have many indirect influences on land use; for example, government policies towards agriculture, location of transportation routes and other developments.

Wise land use, whether on an individual, community, or watershed basis cannot be based, however, on its physical needs and characteristics alone. Land use policies must also consider economic and social aspects. Sometimes indeed one or both of them are more important than the physical.

## 2. Land Resource Problems

### (a) Physical

Before man came to this country, nature had developed her own best uses for the land. White pine grew on the sand plains, hardwoods on heavier soils, cedar and elm in the swamps. Each different soil was producing the kind of growth it was most capable of producing under existing conditions.

As swamps dried up new kinds of vegetation appeared. Forests were replaced with a new kind of tree because the soil's capability to produce hardwoods had been changed.

When man started to use the soil resources of this country, he was not concerned with their conservation. He had little knowledge of, and experience with, the destructive forces of nature in the New World. He had to wrest a living from the land with the simple implements at his disposal and with much hard labour. The practices followed were in keeping with the meagre resources.

The early settler had no information on the capability of the land. This he had to find out by his own experience and observation. We should not now blame our forefathers too much for their mistakes in use and management of the land. All too often later generations have failed to profit by earlier experience.

Slowly we have learned that good land use must be a combination of land capability and man's needs. The soil of a district may be well suited to the growing of a particular cash crop, but if there is no market for that crop, it is useless to grow it.

Basic to any land management program is a knowledge of the physical features and the soil of an area. This can be obtained from careful observation of the soil and its crop response. Many farmers have observed and fitted their farming program to the capability of their land. Other farmers, however, have failed to recognize the needs of their soil and have made little attempt to maintain or improve it.

The need for basic soils information has long been recognized. Both Federal and Provincial Governments in Canada are carrying out soil mapping programs. The Province has conducted conservation surveys in many watersheds in Ontario. Other detailed soil and land-use surveys have been done by municipalities, and by universities. In total, a considerable

amount of information is available on the physical needs and problems of soil and land use. Nevertheless, because of changing conditions continuing surveys are necessary.

Soil and land use information from surveys serves as a basis for government extension programs to encourage better use of the land. Soil survey and conservation reports are available to any landowner who wishes the information. A combination of private initiative and interest, and government support through teaching, extension and research will bring about desirable changes in land use. Changes must be, however, those required by good land management, and by the economic and social problems of the day.

Soil conservation and land management programs are long-range programs. They require the support of every person and every agency concerned with the land.

(b) Economic

The income of any area comes basically from its natural resources, and their availability and use to man. To be economically sound the use of the land and its resources must provide enough income to make the residents financially able to support themselves and provide the various local government services necessary. In Ontario there are many rural, and some urban, areas where this is not possible.

Poor areas are usually poor because of insufficient available resources to support the people living there. Sometimes the resources are present but the people lack capital or knowledge to develop them more fully. Such a situation exists in some parts of Ontario. Residents are attempting to secure a living from land that is marginal or sub-marginal for agriculture. The land may be too poor to produce crops and should be returned to forest or, in some areas, the farming units are just too small to be economic.

In such areas conservation needs may involve a complete change of land use - pasture to forest, or cropland to

pasture. Frequently the landowners cannot afford to make this change. They may not have the initial capital necessary to effect the change or they may not be able to afford a period of lower income during the change period.

In some situations, land uses should be modified to improve rural living standards. This may involve changes to other types of crops, different cultivation methods, or larger farm units.

Taxes, both real and income, have a bearing on land use. Low assessment on marginal land that is capable of improvement may encourage its continued marginal use. Income taxes, and the distinction presently made between capital and income, may influence the use of land. This particularly applies to forestry and woodlot management.

Any Authority program directed towards the use of the land in a watershed, to be effective, must consider the economics of land use. Farmers, just as all other citizens, are working to make reasonable incomes from their operations. It must be demonstrated that recommended land use changes will maintain or increase their income. Some land use and soil conserving measures needed in a watershed may be too expensive to the landowners involved in terms of expected returns. The public, through a Conservation Authority or other agency, must then help bear part of the cost.

Conservation farming makes economic sense. Hundreds of farmers have proved it; nevertheless, those responsible for programs for soil conservation and land use must always be ready to back up their argument with figures. If facts to prove the economic value of recommended measures are not available, it will be much more difficult to "sell" the conservation idea to landowners.

(c) Social

The land should provide the farmer with an adequate income. An adequate income should provide, among other things, a satisfactory standard of living. The use of the land should be suited to the background and experience of the people

concerned. Factors such as the age of the farm operator, his nationality and the opportunities for non-farm employment all influence the pattern of land use.

A farmer chat is well past middle age will normally not have the interest or desire to change his farming practices that a younger man will have. This is most true where there are no sons at home to assist him, and eventually take over. Age, or ill health, will prevent a farmer from farming to the best of his ability.

In those parts of Ontario where farm land is marginal, it will often be found that the age of the farm operator averages some years beyond middle age. The younger people, unable to secure what they feel was a reasonable income from these farms, have left for other employment. The parents carry on as best they can until death or retirement.

In recent years, opportunities for off-the-farm employment have increased greatly in almost all parts of Ontario. This is particularly true around larger cities and towns where there are numerous industries. Members of farm families, and often the farm operators themselves have gone to work in urban centres, while continuing to live on the farmstead. The farm land itself may be completely abandoned as an agricultural operation, or there may be partial or seasonal use of the land in combination with the operator's non-farm employment.

The social life of a community can be an important means of promoting a conservation program. Most communities have several organizations - general farm, women's, junior, and church groups and service clubs. A Conservation Authority in promoting its program is well advised to work with these existing organizations in reaching residents.

(d) Political

In our society, government programs can generally only be successful in so far as people want them. This is true at national, provincial or local levels. A conservation program,

whatever its nature, will be successful only if it is needed and is accepted and benefits people.

In Ontario there are several agencies and departments at different levels ready with assistance for conservation programs. This assistance may be technical or financial. Such government departments as Agriculture, Lands and Forests and Commerce and Development aid in carrying out conservation programs. On a local level county and township councils, and river valley Authorities give assistance to local landowners in the use and management of their land.

To be effective, local residents must have a voice in conservation programs. This is provided for through the elections of municipal councils, and their appointment of members to Conservation Authorities. Authority members know the conservation needs and problems of their communities. Further local voice is provided for in the appointment of advisory boards to the Authority. Advisory boards often include members with a special knowledge of land use, recreation, forestry, wildlife or water problems in the area.

It is important in conservation programs, and particularly in land use, that local people always have a voice. They should never be made to feel that a recommendation or a program is "handed down" to them from a higher level. Instead they should be encouraged to discuss their problems and offer their own suggestions.

CHAPTER 2

## OTONABEE AND INDIAN WATERSHEDS: GEOGRAPHY

### 1. Introduction

The region included in the Otonabee Conservation Authority comprises the watersheds of the Otonabee River, Indian Creek, and the Ouse River. The Otonabee Watershed encompasses an area of 365 square miles, the Indian 89 square miles, and the Ouse 144 square miles, giving the Authority jurisdiction over 600 square miles.

The Authority area is bounded in the south by the height of land known as the Oak Ridges moraine, and by Rice Lake. On the east is the watershed of the Crowe River. The northern boundary is a chain of lakes lying along the edge of the rocky Canadian Shield. These lakes include Chemong, Buckhorn, Clear and Stony. Along the west side is the Pigeon River Watershed.

There are thirteen municipalities in the Authority. These are the city of Peterborough (45,300), the villages of Lakefield (2,100), Hastings (900), Millbrook (840) and Norwood (1,100) and the Townships of Asphodel, Cavan, Douro, Dummer, North Monaghan, South Monaghan, Otonabee and Smith. Of the municipalities, Cavan Township and Millbrook are in Durham County, South Monaghan and Hastings in Northumberland and the remainder in Peterborough County.

A number of railways and highways serve the region. Highways include the Transprovincial No. 7 across the watershed, and No. 28 from Port Hope to Peterborough and north into Haliburton. Highway No. 115 to Newcastle and thence to No. 401 brings Peterborough within 90 miles motor distance from Toronto. Both Canadian National and Canadian Pacific rail lines serve Peterborough on through routes. Several branch lines extend into the surrounding area.


MUNICIPALITIES
SCALE
MILES
D.C.B.D.
CONSERVATION BR.
1961
B.A.E.
DEER BAY
LITTLE MUD LAKE
MOORE LAKE
DUMMER LAKE
KATCHAWANOO LAKE
CLEAR LAKE
LONG LAKE
LAKEFIELD
BUCKLEY LAKE
FLOODED AREA
ROTTEN LAKE
SMITH
DOURO
DUMMER
PETERBOROUGH
LITTLE LAKE
NORWOOD
N. MONAGHAN
ASPHODEL
OTONABEE
CAVAN
HASTINGS
MILLBROOK
S. MONAGHAN
RICE LAKE

Peterborough is the largest municipality in the area. It is the major trading, commercial and manufacturing centre for the surrounding counties. Lakefield is the largest other urban community. It is located some 10 miles north on Highway 28. It is the centre for a particularly thriving tourist trade. Norwood and Hastings Villages are also tourist trading centres.

2. Hydrography

The Otonabee River has its source in Katchawana Lake, at Lakefield. It flows in a generally southerly direction through Peterborough. It empties into Rice Lake at a point about 6 miles from the lake's south-western end. There are four major tributaries of the Otonabee - Jackson, Cavanville, Baxter and Squirrel Creeks. They all arise in the high land on the western border of the watershed and flow east to the main river.

The Indian River flows from Stony Lake and Dummer Lake south to Rice Lake, entering it south of the village of Keene.

These two rivers are part of the Trent River system, which is Southern Ontario's largest. The whole Trent system drains an area of over 5,000 square miles. For a short time during the Lake Algonquin period of glacial history, the Trent River was an important drainage way for the Upper Great Lakes.

The Otonabee and Indian Rivers drain a series of lakes, commonly called the Kawarthas, which include Sturgeon, Pigeon, Stony, Clear and Buckhorn into Rice Lake. This lake in turn flows into the Trent River and hence to Lake Ontario.

The lakes forming the north boundary of the watershed are roughly located along the edge of the Canadian Shield to the north. They were likely formed by glacial action, as they roughly parallel the apparent direction of ice movement. Rice Lake occupies part of a pre-glacial valley.

The Otonabee River flows a length of 35 miles with about 100 feet of fall. The Indian River is about 24 miles long with 150 feet of fall.

3. Physiography

A knowledge of the physiography, or surface relief of a watershed, is helpful in understanding the soils and the problems associated with their use.

Land features of most of the upper part of this continent are chiefly due to the actions of great glaciers. These glaciers once covered whole portions of the continent. They acted as tremendous forces of erosion and deposition; they helped to shape our landscape.

A million years is a relatively short time, geologically speaking, During this time most of Canada has been covered at least four times by great sheets of ice. It has been estimated that in some places these great continental ice sheets were at least two miles thick. These glaciers emanated from two principal centres in the north - the Keewatin district, and the highlands of Labrador and Quebec. They were likely the result of climatic changes; changes which caused the ponderous ice flows to move across the face of the northern hemisphere and recede again. Between the several ice ages there were long periods when the climate was warm, probably warmer than now and the land was ice free.

The last great glaciation is commonly called the Wisconsin, because its results were first identified in that state. It was responsible for much of our present landscape. As it spread out from Arctic regions, its movement may perhaps be compared to the spreading out of a spoonful of pancake batter as it is poured in a pan. As this great continental ice sheet moved forward, it acted as a plough, pushing, scraping and grinding the underlying bedrock and surface deposits. The resultant material is a conglomerated, heterogenous material called TILL.

During its lengthy advances, warmer weather sometimes caused temporary recessions in the glacier, when parts of it melted. One can only imagine the fantastic amounts of water released. These meltwaters, rushing away from the melting face of the glacier carried with them large amounts of loose rock. This rock was later deposited when the volume and velocity of water decreased. Materials deposited in such a manner are said to be "glacio-fluvial" ("glacio" referring to the rocks being pushed about by the glacier, and "fluvial" to the fact that this material is water moved).

Rock materials were often carried great distances from their point of origin. The moving ice also gouged out great rock fragments which scraped at the rock floor over which they were being carried. Sharp corners and edges of even the hardest rocks were ground smooth by this abrasive action. Thus were formed the rounded and smoothed rocks and stones common to glaciated regions, and so common in many parts of Ontario.

(a) The Otonabee Region Watersheds

Two major ice lobes were responsible for the present landscape features of south-central Ontario. One of these advanced from the east into the basin of present Lake Ontario; the other came down from the north. These two lobes met a few miles north of Lake Ontario. Between these two advancing lobes was pushed up a ridge or MORAINE which runs in an east-west direction. This ridge is commonly called the Oak Ridges moraine. It starts at the base of the Niagara escarpment, in Peel County, and runs east through York, Ontario and Durham Counties, to end near Rice Lake. It forms the height of land dividing drainage south into Lake Ontario from drainage north into Georgian Bay, Lake Simcoe and the Trent River system.

The Oak Ridges moraine gives rise to a number of major tributaries of the Otonabee River. Jackson, Cavanville and Baxter Creeks arise in it, and flow east or north-east.


PHYSIOGRAPHY
LEGEND
BOGS AND MARSHES, MARSHY WOODED
DUMMER
DOURO
SMITH
ASPHODEL
NORWOOD
HASTINGS
PETERBOROUGH
N
MONAGHAN
OTONABEE
CAVAN
MONAGHAN
MILLBROOK

It is believed that the north lobe of the last glacier made one final advance before its complete recession and overrode the Oak Ridges moraine. In its path it left the many hills, or drumlins around Peterborough.

There are four major physiographic divisions of the watersheds. These are (1) the Oak Ridges moraine (2) the Peterborough drumlin field (3) the Dummer moraine and (4) the Schomberg Lake plain. These major areas, shaped by glacial action thousands of years ago, have given rise to the various soil and land types of the watershed.

(1) Oak Ridges Moraine

This moraine, or ridge, forms the southern boundary of a part of the watershed. It separates southern drainage by the Ganaraska River, from the land drained north and east by Jackson, Baxter and Cavanville Creeks.

The highest land in the Authority area, at an elevation of some 1,200 feet is found on the moraine in Lot 2, Concession XI, Cavan Township. At many points the moraine elevation ranges between 1,000 and 1,100 feet.

The soils of the moraine are mostly sandy or gravelly. This fact, together with the sharply hilly topography, has led to severe erosion in some spots and extensive areas of moderate erosion. Both wind and water can cause erosion in these soils. Most of the land in the moraine is susceptible to varying degrees of erosion. It should be cultivated with the use of erosion-controlling measures such as long rotations of grass. Large areas of the moraine in the headwaters of the Ganaraska River have been reforested.

(2) Peterborough Drumlin Field

The area about the city of Peterborough and to the east and south of it is characterized by many low, oval, elongated hills. These are known as DRUMLINS. In shape they are rather like the inverted bowl of a spoon and are often called "whale backs".

This long, low, sinuous ridge just north of Warsaw is called an esker. Such ridges are often a source of gravel.

One of the many low whale-back hills called drumlins. This drumlin in Otonabee Township is typical.

Low areas between the drumlins are usually poorly drained. This view is from the crest of a drumlin.

As the glacier passed over this area, it moved huge mounds of rock debris about. Some of the material became plastered onto the bedrock in a thick layer. It ranged in size from fine clay to large rocks. Such material is called TILL. This material gives rise to the varying kinds of soil in this area.

Drumlins have been formed on this area in a manner not yet clearly understood. It is believed, however, that the advancing glacier overrode some impediment. The soil and rock material being carried on the lower part of the glacier became plastered against this impediment, slowly building up the oval-shaped hill. Drumlins usually all face in the same direction indicating the direction of movement of the ice.

The drumlinized area in the Otonabee Watershed is one of the most distinctive in Ontario. It is called the Peterborough drumlin field because the city is in the midst of it; there are in fact several drumlins within the city itself. Probably the one on which Ashburnham Park, in the east part of the city, is located, is the best known. Early writers described Peterborough as being built on seven hills.

Drumlins vary in dimension, but average about 75 feet in height, a quarter-mile wide and up to a mile long. They are closely spaced, averaging four or five per square mile. The low-lying land between the drumlins may be poorly drained or even swampy.

The soil on drumlins in this area is usually reasonably fertile. It is frequently quite stony, as indicated by the many stone fences, and piles in mid-field. The most commonly occurring soil is Otonabee loam. It is a loam, or clay loam soil, often stony and high in lime. Other types are found, particularly between the drumlins.

Agricultural use of drumlinized areas presents many limitations, imposed by steep slopes, stoniness and poorly drained inter-drumlin hollows. The steep slopes on the sides of

drumlins make characteristic up-and-down-hill cultivation difficult and an erosion hazard. In the Peterborough area, the land survey pattern makes the roads, and hence the fences, cross the drumlins at an angle of 45 degrees. This makes across-the-slope cultivation difficult without removal of fences.

The stoniness of drumlin soils has often inhibited cultivation. A few of the steeper slopes have never been cleared of wood cover. The low-lying land between the drumlins varies in its drainage condition. Some is cultivated; some has been drained by tile; a large number of low areas are used for permanent pasture or woodlot.

(3) Schomberg Lake Plain

South and west of Peterborough, running as far as the villages of Millbrook and Cavan, is an area once occupied by a small glacial lake. This lake was once part of a much more extensive area covered by water. This water was caught, just prior to the final retreat of the last glacier, between the Oak Ridges moraine to the south, and the retreating ice mass to the north. This water-covered area, which extended to Lake Simcoe, and west as far as the village of Schomberg, in York County, has been named the Schomberg Lake plain.

Glacial meltwaters, pouring into the lake, carried in soil material which settled to the bottom in the quiet waters of the lake. This has given rise to soils called LACUSTRINE because of their water-laid origin. Such soils may be fine clays, sands or silt. The sands were washed in from the Oak Ridges Moraine.

The swamp to the west of Peterborough, in the north end of Cavan Township, and locally called Cavan Bog, is a residue of the glacial lake.

Soils common to the area are loams - clay or silt. Schomberg, Otonabee and Bondhead loams are well drained. There are smaller areas of imperfectly or poorly drained soils.

(4) Dummer Moraine

In the north-east part of the Authority area, east and north of the village of Warsaw, is a region of rough stony land bordering the Canadian Shield. It extends from the Kawartha Lakes eastward into Hastings County and the Crowe River Watershed. Because this land is typical of Dummer Township, the name Dummer moraine has been applied to it.

The general topography of the area only varies within elevations of about 75 feet; it is relatively low. Nevertheless it is quite rough. Most of it is very stony and the soil is usually quite shallow. There are many areas of exposed rock.

Clear, Stony and Buckhorn Lakes are examples of the long, narrow lakes associated with the rivers that drain this area. There are numerous swamps through the area.

Much of the area has been cleared, and occupied for agriculture. Most of the cleared land is used for pasture, although some fields have been cleared of stones and grow grain. The main agricultural limitations of the soils in the Dummer moraine are stoniness and shallowness. The shallow soils tend to be quite droughty. Their rough bouldery nature presents many problems in land management. The better areas of the moraine are best suited to pasture. Some farmers are producing good pastures; others could profitably improve theirs. Extensive areas should be returned to tree growing.

For a more complete description of the physiography of this part of Ontario the reader should refer to the publications - "Physiography of Southern Ontario"* and the "Surficial Geology of the Lindsay-Peterborough Area"†.

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* Chapman, L.J., and Putnam, D.F. "The Physiography of Southern Ontario" University of Toronto Press, 1951.

† Gravenor, C.P. "Surficial Geology of the Lindsay-Peterborough Area, Ontario, Victoria, Peterborough, Durham and Northumberland Counties, Ontario". Geological Survey of Canada, Memoir 288, 1957. Queen's Printer, Ottawa.

CHAPTER 3

SOILS

1. Factors in their Formation

Soil is the medium in which plants grow. It is found more or less continuously over the land surface, except at polar regions, and in the mountains. Soil forms the link between the earth's rocky core and life upon its surface.

Soil develops from broken-down rock and mineral material. In Ontario this break-down was started by glacial action and completed by various weathering processes - wind, rain, sun, frost. The rock material becomes mixed with organic matter supplied by decaying plant and animal material.

The parent rock material, together with organic matter, air and water are the "building blocks of soil". The proportion of each varies from soil to soil. This is the basis of soil differences. These differences are expressed not only in soil qualities, but in their ability to support plant life.

Most soils are made up of layers. These layers are called HORIZONS. Taken together, these horizons are called the SOIL PROFILE. A soil profile can be described as a vertical cross-section cut to the weathered and unaltered parent material from which the soil was formed.

Examination of a profile can tell the story of the centuries of development behind that particular soil; its examination is basic to any scientific soil study.

Such influences as type of bedrock, climate, slope, vegetation and drainage enter into the formation of a soil profile. The horizons of a profile may be thick or thin. Their colour may vary. They can be likened to the layers of a cake without the frosting between them.

For the purposes of description soil horizons have been given letters. The main horizons are designated as

"A" "B" and "C". Some soils may lack one or more horizons. The main horizons are subdivided into A1, A2, etc.

The "A" horizon is the uppermost layer of the profile; it is the surface or topsoil. Life is most abundant in this layer and most of the organic matter is formed in it.

Immediately below the "A" layer is the "B" horizon, commonly called the sub-soil. It has less life, e.g., plant roots, bacteria, etc., than the "A" layer.

The "C" horizon is the deepest layer. It contains the rock material from which the layers above have gradually been formed. It is therefore called the parent material. It contains little living matter, and is often lighter in colour than the "A" and "B" layers.

Soil formation is a long-drawn out process. It starts with the break-down of rocks by weathering, chemical reaction and other agents. Rock is broken into small pieces, which in turn become still smaller, eventually becoming the particles of mineral soil. Dead and decayed plant and animal material, or organic matter becomes mixed with the upper layers to form topsoil.

There are many differences in soils. They can differ within a field, on a farm to farm basis, or from county to county. Their differences are the basis of soil classification and description.

## 2. Soil Surveys

Just as plants and animals can be named and classified, so can soils. In plants, characteristics such as leaf and flower are used to identify them. In soils, such factors as texture, stoniness, colour, number and depth of horizons, drainage, topography and vegetation are used to identify, describe, name and map them.

Knowledge of the soil, its properties and limitations, is basic to any conservation program. Every farmer

knows whether his soil is sand or clay, poorly or well drained. However, a more scientific designation and description is often necessary. Such information is obtained by means of a soil survey.

Essentially, the purpose of a soil survey is to set up an inventory of the soil resources of an area. In Ontario, soil surveys are carried out on a county basis. They are conducted co-operatively between the Soils Research Institute of the Canada Department of Agriculture and the Ontario Agricultural College's Soils Department.

A soil survey includes fairly detailed examination of all the soils in the county. They are classified into various units; boundaries of the units are mapped and full descriptions made of the various kinds of soil. Field mapping is done, usually on aerial photographs. Later, maps are drawn, and descriptions written for the county report which is published following the survey. These soil reports consist of descriptions of the soil, together with some suggestions for their use and management. Each is accompanied by a map showing location and distribution of each soil.

The soils of any area may be grouped according to the kind and origin of the parent material. These parent materials are derived from the bedrock. When soils are formed from the same kind of bedrock, they are certain to have many similarities. The parent material will likely have been worked out of the bedrock by action of glaciers.

Where a group of soils has been developed from the same kind of bedrock and parent material, they may possess similar layers or horizons. Such a group of somewhat similar soils is called a "soil series". The series is the main unit of soil classification. Each series is given a name - often the name of the township or place near which it was first mapped. Thus a predominant soil series in Peterborough County is the Otonabee.

Within a series the topsoil may have different textures depending on the many factors governing its development over the thousands of years. Thus we may have sand in the topsoil giving a sandy loam, e.g. - Otonabee sandy loam. Soil differentiation based on topsoil characteristics is called a soil type.

Soils may have developed from the same parent material, but have been subjected to different drainage conditions during formation. This can have a great bearing on their development, as can also the amount of slope. Depending on the kind of slope or drainage, they may form different profiles. Differentiation on this basis is called a catena. Thus we may have a well, imperfectly or poorly drained soil developed from the same parent material. But drainage will have significantly affected their qualities and characteristics.

In mapping and describing soils several terms are used in their description:

"Calcareous" - Soil containing sufficient quantity of lime to be alkaline.

"Humus" - well decayed part of the soil's organic matter.

"Structure" - arrangement of individual soil particles into larger units, e.g., sand, which has a single grain structure, or when many particles adhere to give the cloddy structure of clay.

"topography" - refers to the "lay of the land" i.e. - flat, or rolling.

3. Major Soils of the Watersheds*

The classification of soils is based on the method of deposition of the parent material from which they were

* Material in this section taken from "Soil Survey of Durham County", Report No.9, 1946; and from the Soil Map of Peterborough County (available only in photostat).

formed. Chapter 2, dealing with the physiography of the watersheds, has described the main physiographic regions. These were the Oak Ridges moraine, the Peterborough drumlin field, the Schomberg Lake plain, and the Dummer moraine. The soils of the area were developed within these regions from conditions imposed by action of the ice.

(a) TILL Plains - the Peterborough Drumlin Field

Till is that part of the parent material deposited by and underneath the ice. It is usually an unconsolidated heterogeneous mixture of clay, silt, sand, gravel and boulders. Because of this mixture, till can rise to a variety of soils. Over a large part of the watershed, till is derived from limestone bedrock.

The most distinctive feature of this till "plain" is the Peterborough drumlin field. These drumlins, described in Chapter 2, are closely scattered through the area around Peterborough.

The materials within the drumlin are commonly till. Boulders and numerous small rounded stones are well mixed through the clay loam.

The most important soil in this till plain is Otonabee. Indeed it is the most important agricultural soil in the whole Authority area, occupying nearly one-half of the area surveyed.

Otonabee is generally a loam, although in a number of areas, the surface texture is sandy loam. It sometimes tends to be quite stony. It is high in lime, and usually well drained.

Otonabee soils are used for mixed farming. Pasture, hay and grain are grown for the livestock, mostly beef, carried on most farms. Some of these soils, located on steep drumlin slopes, are subject to erosion, and their steepness makes cultivation difficult. Such slopes should be kept in permanent pasture, or planted to trees.

About 5 per cent of the area of till plain is Bondhead soil, either loam or sandy loam. Bondhead is found in small areas in Cavan, North and South Monaghan Townships. Bondhead soils are well drained, sometimes stony. They are usually rolling and make good soils for general farming - dairying, beef, grain, hay and pasture.

In the north-east part of the area watersheds is the Dummer moraine. A line running roughly from Lakefield through Warsaw to Norwood divides this area of shallow soils from the deeper tills of the drumlinized area.

The most common soil is Dummer loam. It occupies much of this region. Dummer is formed from very stony till, and is excessively well drained. The chief limitations of Dummer soil are shallowness and stoniness. Both inhibit cultivation. Where they have been cleared, fair crops are produced, but the occasional outcrops of bedrock, the many stone piles and stone fences, indicate the stony nature of the soil. Dummer soil is best used for pasture or forestry.

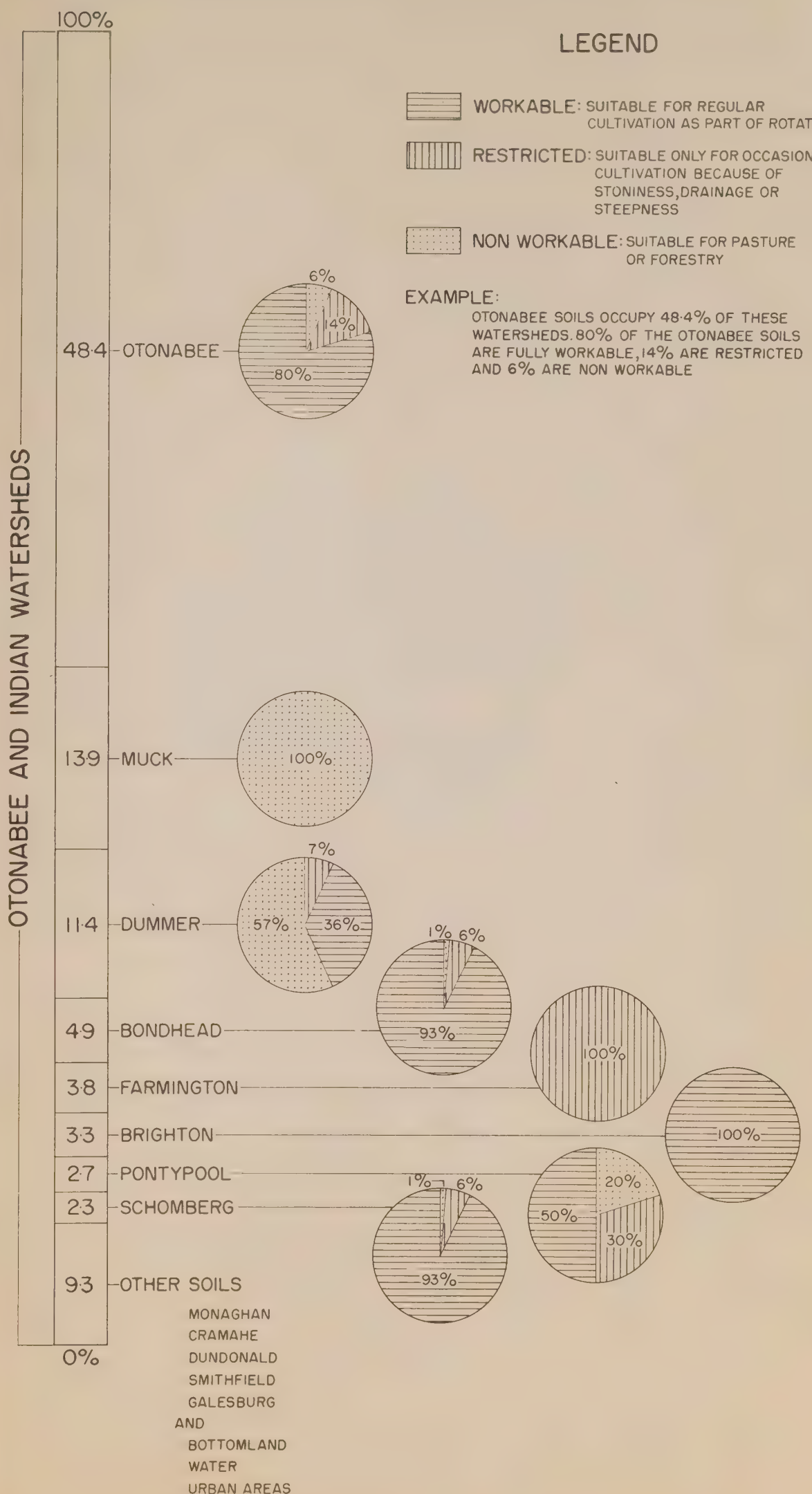
Farmington loam is also found in the Dummer moraine. It is very shallow, less than one foot of soil over limestone bedrock. It, like Dummer, is best suited to pasture or forest production.

(b) Soils Developed from Lacustrine(water-laid)Material - The Schomberg Lake Plain

An area north of the height of land, and running west across central Ontario was once covered by a glacial lake. This is described in Chapter 2. Where this lake occurred, fine-textured deposits were laid down in the still waters. The most important lacustrine deposit is Schomberg.

Schomberg is found in Cavan Township and adjacent North and South Monaghan. Schomberg is a well drained clay loam or silt loam, nearly stone free. The undulating slopes of Schomberg are susceptible to sheet erosion, and control measures such as long rotations are needed. This soil is high in lime and well suited to clovers.

# OTONABEE REGION WATERSHEDS
## MAJOR SOILS AND THEIR WORKABILITY




D.C.& D. CONSERVATION BR. E.E.M. 1960

(c) Outwash Sands and Gravel - the Oak Ridges Moraine

This area is located along the height of land, known as the Oak Ridges moraine, which forms the south boundary of the Otonabee Watershed, west from Rice Lake. The soils are usually assorted sands, gravel and till.

Brighton sand, and Pontypool sand are the most common soils in this area. Small deposits of Brighton sand are found in parts of the watershed, chiefly around Millbrook. They are well drained with gentle to moderately-sloping topography.

Pontypool sand is found along the height of land in the south and west of Cavan Township. Scattered small deposits are found elsewhere throughout the watershed. Pontypool is a well-drained sand or gravel, hilly to rolling in topography. The light soils are susceptible to erosion; this, along with their steep slopes, limits them for agriculture. Some of the Pontypool sand is used for tobacco growing; extensive areas have also been reforested.

(d) Organic Soils - Muck and Peat

Extremely poor drainage conditions cause formation of organic soils. These may be either peat (undecayed organic matter) or muck which is the more completely broken down remains of trees, shrubs and plants.

Several rather extensive areas of organic soils occur in the watershed. Cavan bog, located in the north of Cavan Township is an area of 2,840 acres. Another area several miles in length is Buckley Lake swamp. None of the muck areas has been used for agriculture; they are all covered with tree growth or other woody vegetation.

The above paragraphs have briefly described the main soils of the watersheds; there are a number of others found in small areas and quantities. These include Cramahe, Dundonald, Smithfield and Monaghan.

4. Land Capability

Soils inventories and soils maps are basic tools in developing any system of land management based on soil and

The pasture potential of this Class VII land is very low. This stony land in Dummer Township should be used for forestry.

Class VI land in the north east part of the watershed can produce some pasture if used very carefully.

Class IV land in Smith Township growing good pasture.

water conservation. Soil conservation implies soil maintenance and improvement; this is the ultimate goal of soil management.

Given the information collected and published in soil surveys, and the data from conservation surveys, one has most of the basic information needed to manage, or advise on the management of any soil area. In order to better use this information in terms of describing the production potential of a parcel of land, a land capability classification system has been developed. This system has been developed by the Soils Department of the Ontario Agricultural College, and others interested in land classification. The system is based on one developed by the Soil Conservation Service of the United States Department of Agriculture.

Land classification helps to organize all the soil facts of significance for conservation use. It is known as the "Land Use Capability Classification", the term "capability" referring to the hazards and limitations inherent in a piece of land.

Land capability classification is based on the soil map and such information as topography, slope, drainage, freedom from stones and erosion susceptibility.

To classify land, eight divisions, or classes are used. They are numbered from I to VIII. Soils that can be used in the same way, and that will give about the same crop yield, are grouped into one class.

Classes I to IV are suited to cultivation; classes V to VIII are not generally suited to cultivation and are most useful for pasture, woodland or wildlife and recreational uses.

Capability Classes

A. Land Suited for Cultivation

Class I - consists of land with no, or very slight, limitations to its use. Class I soils are level, deep, well drained and easily worked. They are not subject to erosion or flooding. They are suitable for intensive cultivation without special management measures.

Class II - is made up of land subject to moderate use limitations. These are good soils that can be cultivated with a few easily-used conservation practices.

Soils of this class may have up to 6 per cent slope, be moderately susceptible to erosion or need drainage. They are generally stonefree. Such management practices as soil conserving rotations, grass waterways or tile drainage may be needed.

Class III - is land subject to a number of cultural limitations. Such land may be subject to erosion, have slopes up to 12 per cent, be quite stony or shallow. These limitations often restrict the choice of crops or tillage. Nevertheless Class III land is moderately good land which can be regularly used for crops with proper management.

Class III land requires cropping systems that provide adequate soil cover. Management measures needed are long rotations, including sod crops, contouring and strip-cropping, grass waterways and artificial drainage.

Class IV - is composed of soils with severe permanent cultural limitations or hazards. These soils may be cultivated occasionally with great care. Generally they should be in permanent grass cover.

Class IV soils are subject to such limitations as severe susceptibility to erosion, shallow or infertile soils, poor drainage which cannot be corrected easily, steep slopes, or excess stoniness.

B. Land Not Suited to Cultivation

The soils in the last four land classes are not suited to cultivation, but should be kept in permanent cover.

Class V - This class has few limitations for permanent vegetation. Cultivation is not possible because of wetness or stoniness. In this class are muck soils, bottomlands along river courses, and level stony soils. Under permanent vegetation - pasture or forest - class V lands may be used without limitations.

Class VI - consists of land subject to moderate permanent hazards to their use for pasture or woodland. They may be subject to erosion, be stony, shallow or steep.

Woodlots should be fenced. Pasture use should be adjusted to carrying capacity or season.

Class VII - These soils are severely restricted for forestry or pasture. They may be very steep, severely eroded, swampy, arid blows and/or very shallow with rock outcrops.

Class VII lands have many limitations for pasture or forestry. Mostly, they should be in permanent forest cover. Some may have value for recreation or wildlife.

Class VIII - This class is made up of land that is too rough even for grazing and forestry purposes. Areas such as extremely rough, barren land, or undrainable marshes come in this class. Such lands are best suited for wildlife or recreation.

The lower slopes of this drumlin are growing alfalfa. Class IV and VI land on the steeper slopes on top are kept in tree cover.

Well drained Class III land growing hay and oats.

A small area of Class I land in Smith Township, north of Peterborough.

# CHAPTER 4

## CONSERVATION SURVEYS

During the summer of 1960 a conservation survey* of the Otonabee and Indian Watersheds was carried out by the Department of Commerce and Development. This survey dealt with conditions of renewable resources - water, soil, forests, wildlife and recreation. The land survey was concerned with the various soils and their uses, conditions and problems.

Basis for the land surveys was the topographic maps for the area and aerial mosaic photographs. The former were in a scale of 1:50,000, the latter at 1 inch to 1,320 feet.

The county soil reports and maps were used to provide information on the soils of the region. The conservation survey mapped erosion, drainage and topography and such other significant data as farm ponds, flood plain land, gullies, etc. The existing use of the land was also recorded. Field mapping was done on the aerial photo mosaics.

Time did not permit a complete land survey of the Authority area; therefore a sample area was picked. This was done on the basis of the "blocks" created by the township survey grid of lots and concessions. Concession roads and side roads provided block boundaries. About one-quarter of the blocks in the Authority area were selected in a random manner and surveyed. These 70 blocks with a total area of 75,000 acres represent just over 25 per cent of the Authority area.

This selection, more or less at random, of blocks through the watersheds provided a representative sampling of land conditions. To obtain more information on specific sections, more detailed surveys were carried out in 4 areas. These were (1) Cavan Township (2) Cavan bog (3) Drumlinized till plain - some 22,000 acres of the drumlin area east of Peterborough (4) the area surrounding the City of Peterborough.

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* The Ouse River Watershed was not voted into the Otonabee Authority until March 1961; it was, hence, not included in the survey, and statistics for the Authority area include only the Otonabee and Indian Watersheds.

The special survey of Cavan bog is reported as Chapter 6 of the Land Use report.

1. The Authority Area as a Whole

Physiography and major soils of the part of Ontario in which the Otonabee and Indian Watersheds are located are described in preceding chapters.

Graphs and charts accompanying this section describe land conditions in the area under - (1) major soil types and their workability, (2) Land Capability, (3) Erosion, (4) Drainage, (5) Topography.

(a) Present Use

For purposes of the survey, land use was recorded under four major divisions - cultivated, hay-pasture, woodland and unimproved pasture.

Cultivated land, as mapped, included only that land that was actually under cultivation, i.e. growing grain, rowcrops or in fallow at time of survey. There was 16.5 per cent of the area in this category, including about 0.5 per cent rowcrops, mostly ensilage corn. There is an area of vegetable growing on the south edge of Peterborough, along the Otonabee River. Some tobacco is grown in the Pontypool sandy loams in the south part of Cavan Township.

For the most part, the cultivated land was growing fall wheat, spring grains - oats, barley and mixed grains, and scattered fallow fields.

Hay and pasture land accounts for over 25 per cent of the land use. Included in the category was land normally cultivated as part of the farm rotation, but which was under grass cover in 1960. It was not possible in the early part of the season to differentiate between hay and pasture. Pasture in this category included only "improved" pasture.

Unimproved pasture included 22 per cent of the area. It comprised land on which either no effort at cultivation had been made or cultivating was not possible. Included

here was extensive acreage of the Dummer and Farmington soil types, low-lying wetlands, and the steep slopes of Darlington, Bondhead and Pontypool soils. Land with less than 50 per cent wood cover was described as unimproved pasture; over 50 per cent wood cover, even where pastured, was included in woodland.

Hay and pasture, together with cultivated land, make a total of just over 41 per cent of the area under regular rotation.

Woodland comprises over 30 per cent of the watersheds, and is the largest land use category. Included in woodland is a small acreage of less than 1 per cent that has been reforested.

The Forestry section of the Conservation Report describes the woodland in detail.

The remaining 7 per cent of the land area was in such uses as urban, roads, non-farm rural, and water (including streams and inland lakes and ponds).

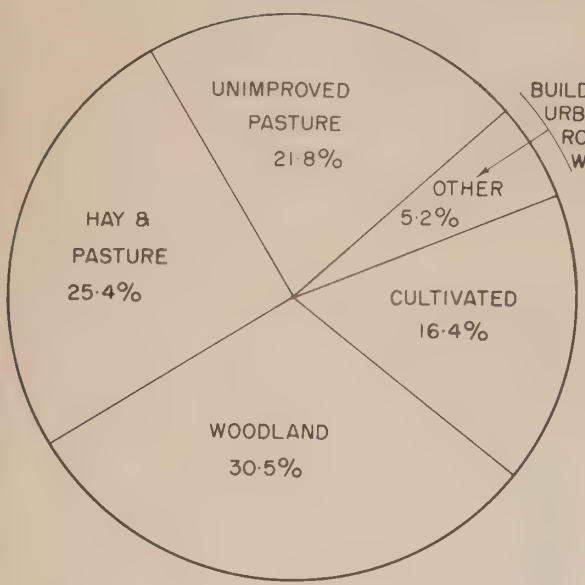
(b) Land Conditions

(1) Slope

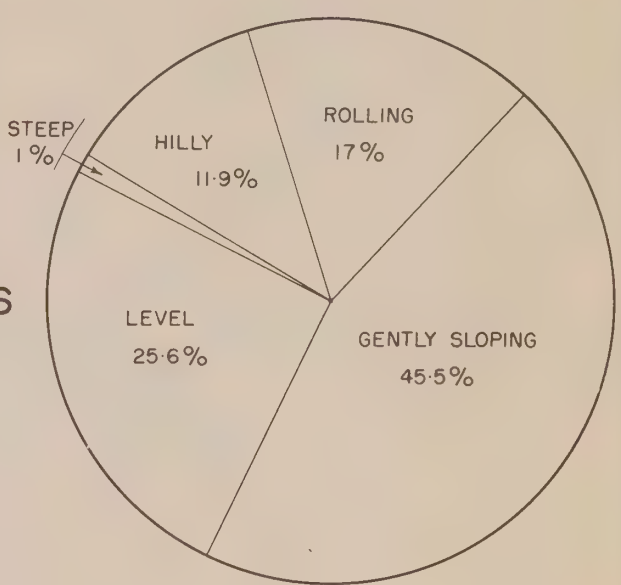
The amount and degree of slope that exists has a major bearing on the capability of a piece of land. For that reason, slopes were mapped during the survey. In the sample blocks over the watershed some 8 per cent was mapped as level, with slopes not exceeding 2 per cent. Gently sloping, with slopes not exceeding 6 per cent, accounted for over 40 per cent of the area. Rolling land, with slope range of 6 per cent to 10 per cent occupies 15 per cent of the area while hilly land (10 per cent to 25 per cent slopes) and steep (slope over 25 per cent) accounted for 10.7 per cent and 0.06 per cent respectively.

Steepest slopes are found on the Otonabee and Pontypool soils. The many drumlins account for the steepest slopes of Otonabee soil. Mostly, the slopes are short, and

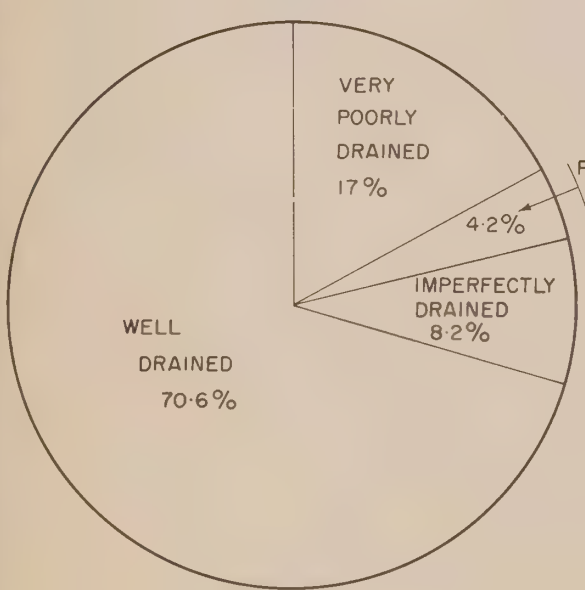
# OTONABEE REGION
# EXISTING LAND CONDITIONS
# IN THE AUTHORITY AREA



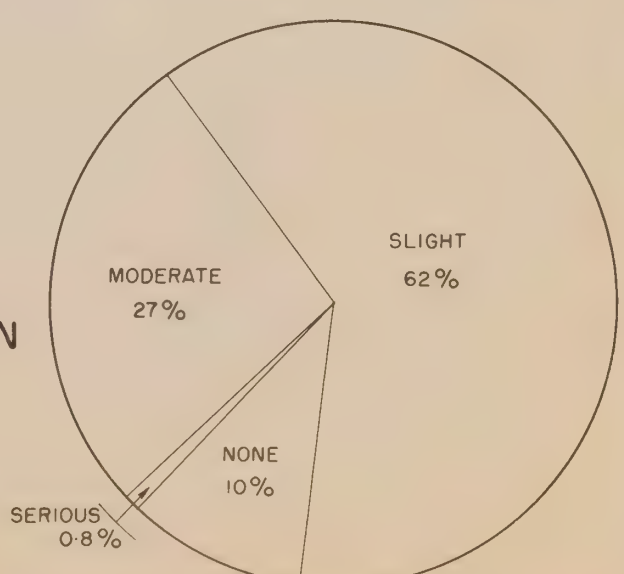

## PRESENT LAND USE




## SLOPES




## DRAINAGE



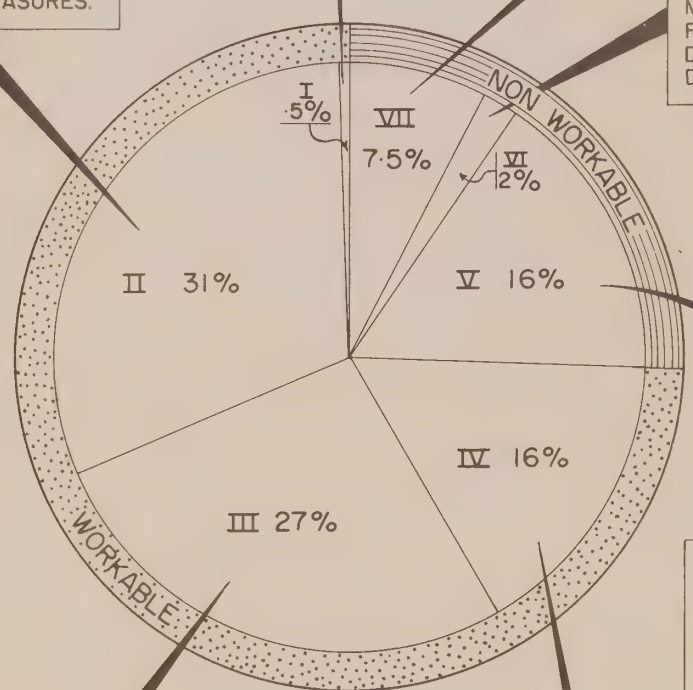

## EROSION

D.C. & D. CONSERVATION BR. JAN. 1961, E.E.M.

# OTONABEE REGION

## LAND CAPABILITY CLASSIFICATION

### WITH PERCENTAGE OF WATERSHED AREAS IN EACH CLASS




**CLASS I**

EXCELLENT LAND. MAY BE USED FOR EXTENSIVE CULTIVATION WITHOUT LIMITATION OR SPECIAL CONSERVATION MEASURES.

**CLASS VII**

SEVERELY LIMITED FOR GRAZING OR FORESTRY DUE TO VERY STEEP, ROUGH OR WET LAND.

**CLASS II**

VERY GOOD LAND. MAY BE USED WITH MODERATE LIMITATIONS FOR CULTIVATION, WITH SOME CONSERVING MEASURES.

**CLASS VI**

MODERATE LIMITATIONS FOR PASTURE OR FORESTRY DUE TO STONINESS, DROUGHT OR STEEP SLOPES.

**CLASS V**

UNSUITED TO CULTIVATION BECAUSE OF WETNESS, FLOODING OR STONINESS. USE FOR PASTURE OR FORESTRY.

**CLASS III**

GOOD LAND, BUT WITH SOME SERIOUS LIMITATIONS. NEEDS CONSERVATION MEASURES FOR CULTIVATION.

**CLASS IV**

MODERATELY GOOD LAND, BUT WITH SEVERE LIMITATIONS. CULTIVATE ONLY OCCASIONALLY WITH GREAT CARE.

D.C.&D. CONSERVATION BRANCH E.E.M. 1961

generally in grass. Pontypool soils in Cavan Township have longer slopes, and are subject to erosion.

Bondhead and Brighton soils, common to Cavan Township are level or gently sloping. The Dummer soils, so common in the north-east part of the Authority area have slopes generally between 3 per cent and 7 per cent and hence are described as gently sloping.

(2) Erosion

Considering the watersheds as a whole, erosion is not a serious problem, as may be seen from the accompanying graph. Pontypool soils are subject to the most serious erosion, and they occupy only 3 per cent of the area of the watersheds. On the most seriously eroded Pontypool soils, located in Cavan Township, the problem has already been recognized, and the worst problem areas have been reforested, or are in permanent grass cover.

Nevertheless, although there is little serious erosion, a large part of the area has been subjected to at least some erosion. Usually this is sheet erosion, slowly removing the topsoil layer. Measures to prevent or curtail sheet erosion are necessary in many fields. Such measures will increase soil fertility and organic matter, and hence productivity.

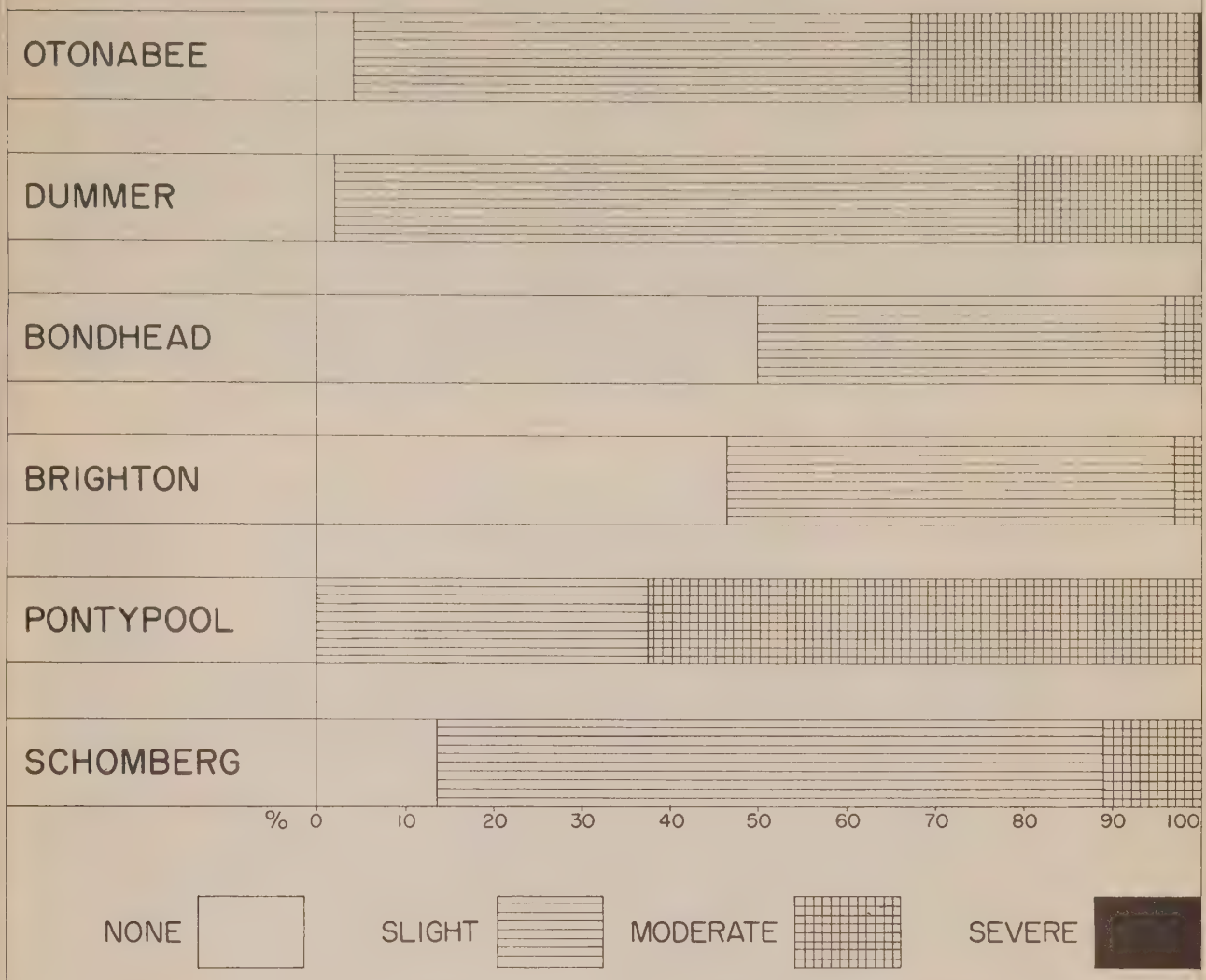
(3) Drainage

Most of the agricultural soils of these watersheds are well drained, in fact some are excessively so. However, about 14 per cent of the area surveyed is classified non-agricultural because of poor drainage. This is made up of muck, marsh, swamp and bog areas that have no agricultural value under present conditions. Such areas as Cavan bog, Buckley swamp, and the extensive scattered wetlands in Douro and Dummer Township, and the marsh areas along the streams, and at the mouths of the rivers have no present agricultural value. Such tree growth as they produce may have limited value but is mostly scrub. These areas cannot be used for crop production unless drained and it is doubtful that even if drained they would have much agricultural value.

# OTONABEE REGION

# EROSION IN RELATION TO MAJOR SOILS AND TO SLOPE

## RELATIONSHIP BETWEEN EROSION AND SIX MAJOR SOILS OF THE WATERSHEDS




## RELATIONSHIP BETWEEN EROSION AND DEGREE OF SLOPE ON WATERSHED LAND

### OCCURRENCE OF EROSION ACCORDING TO SLOPE DESCRIPTION

| EROSION \ SLOPE | LEVEL 0–2%* | GENTLY SLOPING 2–7% | ROLLING 7–10% | HILLY 10–20% | STEEP 20% + |
|---|---|---|---|---|---|
| NONE | 7·4% | 2·8% | | | |
| SLIGHT | 3·0% | 43·5% | 12·6% | 1·4% | |
| MODERATE | | 4·3% | 10·3% | 13·6% | ·7% |
| SEVERE | | | | | ·4% |
| VERY SEVERE | | | | | |

* PERCENT SLOPE INCLUDED IN EACH SLOPE DESCRIPTION

D.C.&D. CONSERVATION BR. E.E.M. 1961

Stony Class VII land on the Dummer moraine should be in forest. There are extensive areas of such land in the Authority.

Class V land, - low, poorly drained.

A small area of Class II land on the Dummer moraine near Warsaw.

Of the land producing crops or pasture, over 80 per cent is well drained and 8 per cent imperfectly drained. Monaghan, Tecumseth and Smithfield soils are the main imperfectly drained ones; with improved drainage, they are quite productive. Tile drainage is generally recommended.

Poorly drained soils are often found in the depressional areas between the drumlins. Many of the inter-drumlin areas are Lyons soil. Some have been drained and are in cropland, many are in unimproved pasture, scrub or woodland. Generally they will not repay the cost of artificial drainage, particularly where the soil is stony.

2. Cavan Township

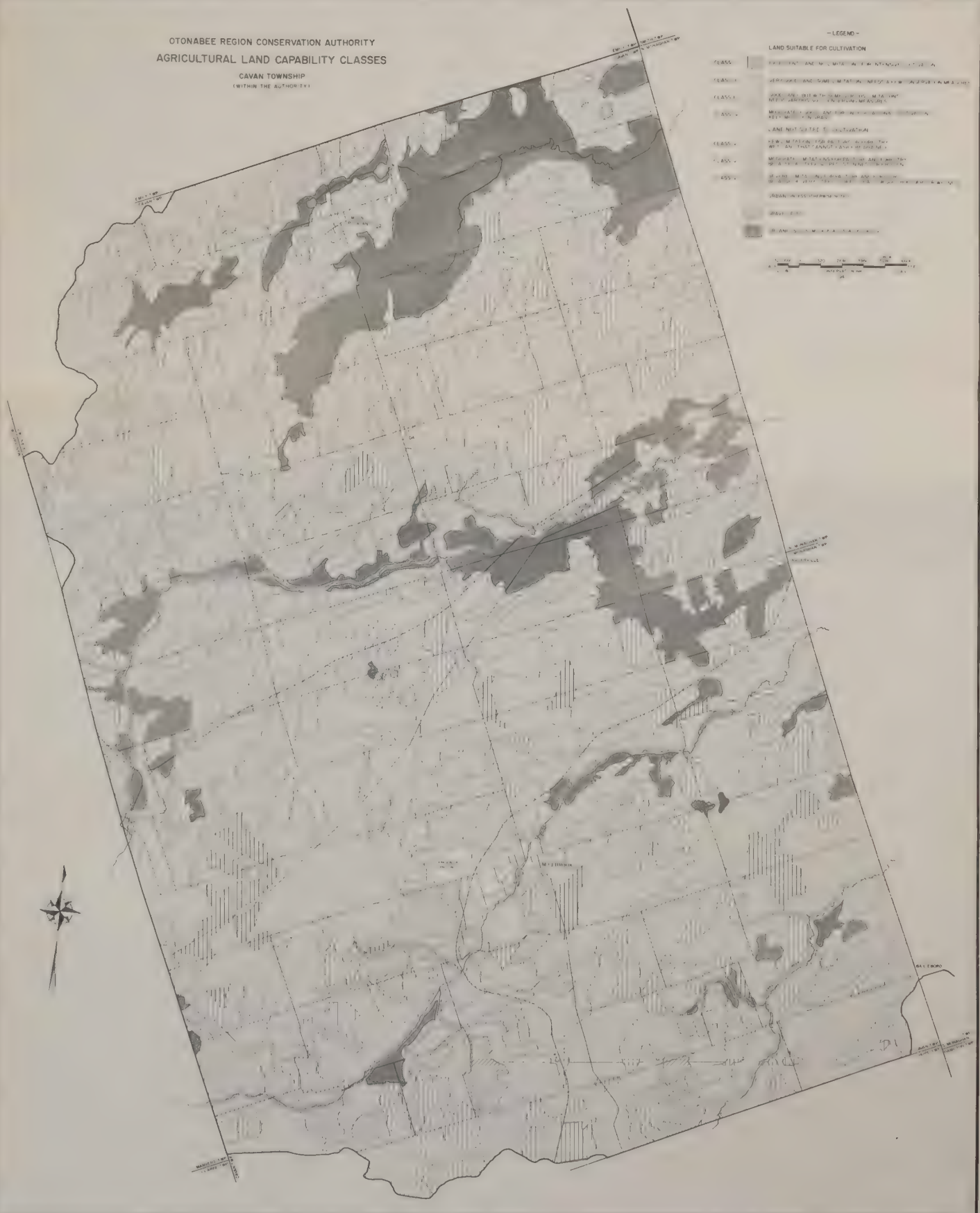
Cavan Township, or that portion of it within the Authority, was selected for a more extensive sample survey. The township was picked because it presented a greater diversity of topography and soils than other similar areas within the Authority. Cavan Township totals 62,180 acres, of which 61,330, or 98.5 per cent is within the Otonabee Watershed.

Southern and westerly parts of the township are in the Oak Ridges moraine. The north part is till plain, on which are numerous drumlins, while the central part was once covered with glacial Lake Jackson.

(a) Present Use

Land uses in Cavan Township are essentially the same as for the whole Authority area. Cultivated land (only land actually broken up and in grain or fallow) took up about 22 per cent of the area, of which less than 1 per cent was in row crop. Tobacco and corn made up the row crop acreage, with tobacco being grown in the Pontypool sands in the south part of the township. Only a small portion of the extensive tobacco growing area in Durham County south of the moraine extends into Cavan.

Fall wheat, oats and mixed grain make up most of the cropland. Most of the grain is grown for feeding live-stock on the farm.


OTONABEE REGION CONSERVATION AUTHORITY
AGRICULTURAL LAND CAPABILITY CLASSES
CAVAN TOWNSHIP
(WITHIN THE AUTHORITY)
- LEGEND -
LAND SUITABLE FOR CULTIVATION
LAND NOT SUITABLE FOR CULTIVATION

Hay and pasture land takes in over 23 per cent of the township. This is land which can be cultivated, but at the time of the survey was in grass. Unimproved pasture accounted for another 22 per cent. This category included land with less than 50 per cent tree cover. All types of land in grass account for 45 per cent of the township area.

Over 30 per cent of Cavan Township is in woodland. This category includes all land more than one-half covered with trees. About 1,000 acres are reforested land.

Over one-half of the township has either never been cultivated (woodland) or has not recently been broken up (unimproved pasture). Although about 70 per cent of the township area is of a land capability suitable for cultivation, only about 45 per cent has recently been cultivated.

(b) Land Conditions

(1) Slope

About 20 per cent of the township area has slopes not exceeding 2 per cent (2 feet per hundred) and hence can be classified as level. Another 45 per cent has slopes ranging from 2 per cent to 7 per cent, and is described as gently sloping. Hummocky or rolling land accounts for over 15 per cent; hilly, with slopes up to 25 per cent, for over 17 per cent of the township area.

Considering limitations of slope alone, some 65 per cent of the township could be regularly cultivated. Otonabee and Pontypool soils have the steepest slopes. Bondhead and Schomberg soils, occupying 15 per cent of the Township's area, have the most level land.

(2) Erosion

As might be expected, the soils with the steepest slopes, Pontypool and Otonabee, are subject to the most erosion. Portions of the land most subject to erosion have been reforested. Fortunately, less than 1 per cent of the area of the township is being severely eroded.

About 6 per cent of the township's lands show few signs of erosion; 50 per cent are subject to slight erosion, and 26 per cent to moderate erosion.

Although erosion is not a serious problem in management of the land, it is none the less a factor in reducing the capability and potential crop response on many farms. Moderate erosion may not appear serious, but since it generally occurs as sheet erosion, may proceed for years with the landowner paying little attention. In this time it often destroys the topsoil, and makes good crop production more difficult and more expensive.

(3) Drainage

Nearly three-quarters of Cavan Township is well drained; about 5 per cent is imperfectly drained, and 6 per cent poorly drained. Some of these soils can often be artificially drained to make them adaptable to a wider range of crops.

About 15 per cent of Cavan Township is classified as very poorly drained. It mostly consists of bogs, marshes and bottomland. The largest single area is Cavan bog, which is described more fully in Chapter 6 of this report. Most of the very poorly drained land has little agricultural value, and should remain in its present state - that of forest cover. Much of it could be improved for this purpose from its present state.

3. Drumlinized Till Plain

The drumlinized till plain, otherwise called the Peterborough drumlin field, is described with regard to its physiography, in Chapter 2. It is one of the outstanding landscape features of the Otonabee Watershed. An aerial photograph shows the characteristic pattern of many low oval hills all pointing in the same direction.

To obtain a more detailed picture of land conditions in this rolling drumlin area, a sample survey of some 20,000 acres was done. This acreage was contained in a strip running east from the city of Peterborough along both sides of

No. 7 highway to the eastern boundary of the Indian Creek Watershed.

(a) Present Land Use

The land-use pattern in the drumlin area shows but slight variation from that of the whole watershed. About 15 per cent of the land is in grain or row crops, 28 per cent improved pasture or hay, 21 per cent unimproved pasture and 32 per cent woodland. As compared to the whole Authority area, these figures show a decrease of 2 per cent in grain, and increases of 2 per cent in woodland and 3 per cent in improved pasture or hay.

(b) Land Conditions

Nearly 90 per cent of the soil of the sample strip is Otonabee. This sandy loam is high in lime, moderately stony and fairly easy to cultivate. This soil provides a good basis for the livestock industry, both beef and dairy, which predominates in the farming picture. Commercial fertilizers are used to some extent; greater use would be beneficial as the soils are only moderately fertile.

Small amounts of Bondhead (4 per cent), Brighton sandy loam (1 per cent) and Cramahe gravel are also to be found. The Cramahe gravel is common to the ridges or eskers which run through the area. It is of little use for crops but does provide a gravel source for construction and road building.

The largest part of the drumlin area (43 per cent) can be classified as gently sloping, with slopes not exceeding 6 per cent. About 14 per cent is level - found mostly in the inter-drumlin areas. Some 26 per cent has slopes between 6 per cent and 10 per cent and is rolling. Another 15 per cent is hilly and 2 per cent is steep with slopes over 25 per cent. These slopes are characteristic of a drumlin area. They do not present any serious hazard to cultivation. However, the hilly and steep land on the sides of some of the drumlins should be under permanent sod, or trees.

In common with the rest of the watershed, erosion is not a serious problem, with nearly three-quarters of the area showing only slight erosion. Moderate sheet erosion occurs on some of the steeper slopes; measures should be taken to protect this land.

Some poorly drained and swampy areas are found in the low land between the drumlins. Some of it has been drained; most such land is in rough pasture or in bush.

4. Area Adjacent to the City of Peterborough

Considerable areas of land along the river and canal are owned by the Canada Department of Transport. It would be desirable if a larger portion of land along parts of the river and canal could be brought under public ownership. A scenic parkland strip, more adequate and attractive than now exists, could be developed along the river south of the city.

Some land along the banks of the Otonabee River, south of the city is subject to flooding at periods of high water level such as occurred in the spring of 1960. This area, located in Concessions IX and X of North Monaghan Township along the west side of the river, is presently mostly used as farmland or for market gardening. Building on this land should be restricted until such time as means are worked out to more closely control water levels in the Otonabee System.

North and west of the present city limits Jackson Creek flows from Cavan bog through a very small lake called Lily Lake, and through the city into the Otonabee. On the edge of the city this stream flows through a deeper valley. This valley is a valuable asset in the topography of the area, and could provide a scenic "green belt" or conservation lands. Their use for these purposes should be encouraged.

The agricultural use of farmland adjacent to growing urban areas is often affected. Factors such as the amount of land held by speculators, increasing land values, high taxes and opportunities for non-farm employment often tend to

discourage use of otherwise fertile land for farming. Around many major urban centres large tracts of land lie idle, either awaiting urban development which may not come for years, or idle because owners have found remunerative off-farm employment. Such effects on rural land surrounding urban areas are sometimes described as "sterilization".

No actual investigation was made during the conservation survey to determine urban effects on rural land around Peterborough. However, a survey of present land use was made, and this indicated very little land that could be classified as idle. Whatever effects any increases in land values or real estate taxes may have on land around the city, most of the land is still being actively used for agriculture.

Peterborough is the only major urban centre in the area of the Authority. During the past 20 years, its population has doubled from 25,500 in 1940 to over 50,000 in 1960. During the same period there has been considerable urban growth in the surrounding townships of North Monaghan, Smith, Douro and Otonabee. It is estimated* that the total population of the Peterborough area will reach 67,000 by 1970 and be in excess of 85,000 by 1980.

Some special attention was given as part of the conservation survey to the area adjacent to the city boundaries. This was done because land conditions are often most critical in areas changing from rural to urban use. There is little doubt that Peterborough will find it necessary to expand its boundaries as it has done several times in the past 20 years to accommodate its increasing population.

While land resources in the Peterborough region are plentiful, this does not reduce the need for careful survey of these resources in light of the anticipated need. It seems likely that urban expansion will continue to be most rapid

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* Ontario Dept. of Economics, "Population Projections for the Economic Regions, Counties and Urban Areas of Ontario, 1956 to 1976".

towards the west and south-west. This has been the pattern in the past. To the east of the city, the Otonabee River and the canal tend to form barriers to providing services to expansion. The topography east of the city is less satisfactory for building, with many steep-sided drumlins and poorly drained inter-drumlin areas.

Land surrounding the city is generally farmland. Much of the soil is Otonabee loam - well drained, usually somewhat stony, and rolling to hilly. There are some poorly drained depressional areas. The land west of the city is broadly rolling with fewer drumlins and fewer wet depressions than to the east and north. This makes the area to the west reasonably well suited to building purposes.

While the Trent Canal and the Otonabee River tend to be a barrier to easterly expansion of the city, they are at the same time a great asset. The canal and its locks attract many tourists both by water through the canal system, and by road to look at the locks. Good planning will preserve and develop this asset by keeping it free from undesirable encroachment. As well as being an attraction in itself, the river system flows through often scenic surroundings. This is particularly true to the north of the city.


OTONABEE REGION CONSERVATION AUTHORITY
CITY OF PETERBOROUGH AND ADJACENT AREA
SHOWING
EROSION CONDITIONS

OTONABEE REGION CONSERVATION AUTHORITY

CITY OF PETERBOROUGH AND ADJACENT AREA

SHOWING

# DRAINAGE CONDITIONS

# CHAPTER 5

## USE AND MANAGEMENT OF THE LAND

### 1. Past Development

Prior to 1818, the Otonabee Watershed was covered with forest which no settler had penetrated. In 1818, immediately following the completion of the township survey, a party of English immigrants settled in Smith Township, on the present border of Peterborough.

Settlement in the area proceeded slowly. By 1825 only a handful of settlers were to be found in Otonabee and Douro. There were but two or three in the present area of Peterborough which was then called "Scott's Plains". But during 1825, a large number of Irish immigrants were brought to the township. Each family was allotted 100 acres, on which a shanty had to be built. To enable them to make a start in the new land, each family received "a cow, an axe, an auger, a handsaw, a hammer, 100 nails, 2 gimlets, 3 hoes, 1 kettle, 1 frying pan, 1 iron pot. 5 bushels of seed potatoes and 8 qts. of Indian corn".*

The energy of these early settlers is shown by the following figures giving the results of their first year's work.

| Township | No. of Locations | No. Acres Cleared | Produce Raised-Bushels | | |
|---|---|---|---|---|---|
| | | | Potatoes | Turnips | Corn |
| Douro | 60 | 245 | 8,250 | 4,175 | 1,777 |
| Smith | 34 | 113 | 4,800 | 1,550 | 637 |
| Otonabee | 51 | 186 | 10,500 | 4,250 | 1,395 |

During 1827, it was reported that a surplus of wheat was grown, and that some 5,000 bushels were sold to Peterborough merchants.

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* Poole, T.W, M.D. "A Sketch of the Early Settlement and the Subsequent Progress of the Town of Peterborough and the County of Peterborough", 1867. Printed by the Peterborough Examiner, and reprinted with additions, 1941.

Encouraged by the success of these early immigrants, more settlers came into the area. By 1838, Peterborough had some 900 inhabitants with 150 houses. Roads were being built in the townships, as were mills. After the settlers had cleared sufficient land to build their homes, and grown enough crops to feed their families, they turned to some crop that could be sold or bartered. For many parts of Ontario this meant wheat.

The part wheat played in the early agriculture of this region is noted in the report of the Colborne District Agricultural Society for 1847. It stated that:

> ".....we find much cause for congratulation in the steady and rapid advancement in both the quality and quantity of the agricultural products of this District since the formation of this Society. This advancement is perhaps most observable in the article of wheat and flour. Up to the year 1842, it is known, not more than 2,000 bushels of wheat was sent out of the District for sale in any one year. During the last year (1847) upwards of 20,000 bbls. of flour and 30,000 bushels of wheat were sent off by the merchants of this district alone; independently of the large quantities of wheat (probably not less than 50,000 bushels) taken out by the farmers themselves and sold at the ports on Lake Ontario".

This same report mentions that there were no mills capable of manufacturing flour in 1842, but in 1847 there were eight. In 1842 only one threshing mill existed; now 50 are in use, 30 of them having been manufactured by a Peterborough factory. In 1847, local factories made 800 ploughs. Many horse rakes, drill ploughs, harrows, cultivators and other implements were in general use.

Within the same period several woollen mills had been built. The market they offered was credited with a marked expansion and improvement in sheep raising. Similar improvement was noted in cattle, but regret is expressed that similar good changes had not extended to horses.

The first railroad to reach Peterborough was built in 1854 across Rice Lake from Cobourg. Its usefulness was short-lived because of the difficulties of keeping the line

across the lake intact against the ravages of winter storms and ice. In 1858 a feeder line from the Port Hope to Lindsay line was extended into Peterborough. Rail service ended the isolation of the inhabitants, and greatly extended their markets.

By 1865, it is reported that 37,000 bbls. of flour, 31,775 bushels of wheat, and 13,960 bushels of barley were shipped from the Peterborough railway station.

The first cheese factory for the area was built in Smith Township in 1866.

Fife Wheat One of the noteworthy events in the history of agriculture in Canada was the introduction of Fife wheat and its subsequent use in the development of many other varieties and strains. Fife wheat was first grown on the farm of David Fife, Otonabee Township about 1842. The story of wheat is inseparably connected with Canada's history, the building of our railroads, the growth of our cities and of our western provinces.

The publication "Canadian Farm"* carries a letter from Mr. Sylvester Fife, David Fife's son, in which he describes the introduction of this famous wheat in part as follows:

> "The late David Fife, Otonabee, wished to see the quality of Canadian wheat improved, and sent to Scotland for samples. Some were sent to Port Hope, where they lay in warehouses over winter. They were sowed in the spring, but came to nothing. My father then wrote again to his friend, Mr. Struthers, clerk in a grain store in Glasgow, for the second supply of wheat. Mr. Struthers noticed a new kind, an excellent sample, brought by ship direct from Danzig. He thought it would be just the kind for Canada, and sent two samples, one of fall wheat, and the other of spring wheat. These were sown in the year 1841. They also laid in the storehouse at Cobourg during the fall and part of the winter. In the spring each sample was sown. The fall variety came to nothing, but the spring sample proved superior to any other kind sown. Out of this, 3 ears were saved.

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* Reprinted from "Canadian Farm" April 12, 1912, as published in 1941 reprint of "A Sketch of the Early Settlement..... in the County of Peterborough", T.W. Poole, M.D.

This was on the farm of my father, David Fife, now occupied by me. But owing to the illness of my mother, who took special charge of this wheat, it was not sown until after the other wheat was above ground. At harvest time the Siberian wheat was badly rusted, whereas this sample was not affected in the least. This crop was gathered by my mother and brother David and carefully stored away. They had now realized a quart of seed. This was sown the following spring by my mother and brother and produced one-half bushel at harvest time, and from the produce of this half bushel, my neighbours were supplied and the country benefited by the introduction of Fife wheat. Among other neighbours, Mr. Henderson bought a bushel, and from the second sowing of the same reaped 300 bushels, part of which he carried to Keene and turned in to the agricultural society for $3.00 a bushel, wrongly calling it the Glasgow wheat. It never grew in Scotland but was imported directly from a ship arrived from the Baltic."

2. Present Use

Agriculture in these watersheds centres around livestock production, milk and meat. Cheese production used to be important but in the past 30 years it has been replaced by whole milk production for the local market and, increasingly, for the Toronto markets. Considerable milk goes into ice cream, powdered milk and other uses. Dairying is the most important enterprise, with 1959 figures in Peterborough County, indicating over 16,000 head of stock kept for dairy use as against 9,000 for beef purposes. Hogs are an important source of income on many farms. Poultry has ceased to be a sideline and indeed many farmers no longer keep poultry even for family egg supply. It has become a specialized type of farming with large investments in buildings and equipment.

Climatic conditions do not favour the growing of cash crops such as grain corn, orchard fruits and canning crops. An exception is the extension of the Durham County tobacco-growing area into the south edge of Cavan Township, along the moraine.

The conservation survey of the area included a 25 per cent sample survey of present use of the land in the watersheds. It showed the following major uses:-

1. Cultivated - grain, row crops or fallow 16 per cent
2. Hay pasture - improved pasture or hay crops 25 " "
3. Pasture - unimproved 22 " "
4. Woodland 31 " "

The considerable acreage of woodlots can be accounted for by the extensive areas of low-capability land to be found in parts, particularly north and east, of the watersheds. The need for high-quality hay and pasture is reflected in the fact that 25 per cent of the area is devoted to it with a further 22 per cent of unimproved pasture; in other words, nearly 50 per cent of the region is growing feed for the dairy and beef industry.

In a broader sense, an important factor in land use, and in the economy of some parts of the watershed is the tourist industry. The shores of the lakes bounding the Authority area, and of the Otonabee River, are sites for hundreds of cottages. Supplying the needs of the tourist industry is an important income source for some local residents.

IMPROVED LAND AREA, NUMBER OF AND AVERAGE SIZE OF FARMS IN MUNICIPALITIES IN AUTHORITY AREA IN ACRES*

| Township | Total Area Occupied Land | Area of Improved Land | Per Cent | No. of Farms | Average Size |
|---|---|---|---|---|---|
| Douro | 33,345 | 18,774 | 55 | 211 | 158 |
| Dummer | 37,600 | 15,469 | 41 | 186 | 202 |
| Monaghan N. | 10,602 | 6,986 | 66 | 87 | 122 |
| Otonabee | 60,359 | 39,438 | 65 | 395 | 153 |
| Smith | 44,393 | 28,054 | 63 | 255 | 174 |
| Monaghan S. | 18,061 | 12,019 | 66.5 | 115 | 120 |
| Cavan | 53,259 | 32,973 | 61.5 | 334 | 160 |
| Total | 257,619 | 153,713 | 40 | 1,583 | 163 |

* Data from Dominion Bureau of Statistics Census, 1956.

3. Future Land Use Changes

That there will be many changes in agriculture and land use requirements in Ontario during the next 15 years is very evident from the rapid and many changes in recent years. These changes will affect different parts of Ontario in different ways. Just what form they will take can only be an "educated guess" based largely on past patterns and projected population figures.

Population figures, past, present and projected future, for the Peterborough area, are as set forth in the following tables:-

POPULATION: PAST TRENDS*

| | 1901 | 1911 | 1921 | 1931 | 1941 | 1951 | 1956 |
|---|---|---|---|---|---|---|---|
| Peterboro Co. | 36,066 | 40,783 | 42,261 | 43,958 | 47,392 | 60,789 | 67,981 |
| Peterboro City | 11,239 | 18,360 | 20,994 | 22,327 | 25,350 | 38,272 | 42,698 |

POPULATION: FUTURE PROJECTIONS*

| | 1961 | 1966 | 1971 | 1976 |
|---|---|---|---|---|
| Peterboro Co. | 79,000 | 88,000 | 98,000 | 111,000 |
| Peterboro City | 51,000 | 57,000 | 63,000 | 70,000 |

* Information from "Population Projections for Economic Regions, Counties and Urban Areas of Ontario, 1956 to 1976" Ontario Department of Economics.

Most of the projected future growth of Peterborough County will take place in and adjacent to Peterborough City. Rural farm population will likely continue to decline. There will likely be increases in the rural non-farm population, particularly if industrial employment opportunities in larger urban areas continue to increase.

Soils and climate in these watersheds are such that no major changes in rural land use are likely to occur.

The region will continue to be livestock country. There may be a continued shift to dairy production with the increasing demands for milk in urban centres.

The difficulties of economical agricultural production may cause some of the marginal land, now in agriculture, to go out of production. Some of the land in the Dummer moraine should best be used for permanent pasture or for forest production. It seems likely that when present owners are through with some of the properties, this will happen.

Recreation and the tourist industry will play an increasingly important part in the region. An increasing population, not only within the region, but also beyond, will seek cottage sites, playgrounds and public parks. It is unfortunate that, even now, little of the extensive lake shoreline is available for public recreation. Recreation can perhaps be combined with forestry in some of the marginal land areas now being used for subsistence agriculture.

## 4. Soil Management Problems

Many factors contribute to problems in management of soil. Some are physical problems of the land, others are economic or social. This report is concerned with the physical problems of soil management.

In Ontario, the main problems of soil management are those of drainage, fertility and erosion. On any one farm, or on any one piece of land, one problem may predominate; often, however, it is a combination of all three.

### (a) Drainage

Of the various problems of managing the soil, one of the biggest is the safe disposal of excess water. Its uncontrolled run-off can cause erosion. When desirable, as much as possible should be allowed to soak into the ground.

Excess moisture may be on the land surface, or within the soil itself. On most farms it is necessary to get

rid of both. Adequately drained land is necessary to good farm management.

Surface Drainage

To safely remove excess water from the surface of the soil may require special measures. These may include grass waterways, diversion ditches and protective measures along streambanks.

There are many places in the Authority area where grass waterways and other surface water disposal systems are needed. These may include ditches on farm fields, or improved ditches and culverts along township and county roads.

Internal Drainage

A system of tile drainage is often used to remove excess internal soil moisture. Tile drainage of wet soils is a major contribution to soil conservation. Some of the most productive soil in Ontario is only productive because it has been drained. Drainage allows increased yields of crops in low, wet areas and permits slopes, where serious erosion is likely to occur, to be planted to more appropriate crops. The controlled removal of excess water from fields can be an aid in combatting soil erosion.

Poorly drained fields, when tile drained, permit increased yields of crops of better quality. The growing season can be longer by reason of earlier planting. With drainage, more flexible, better crop rotations and management practices can be used.

(b) Fertility

Soil fertility is the ability of any soil to supply the nutrients necessary to plant growth. Maintenance of soil fertility is one of the major management problems of Ontario soils.

Differences in the productive capacity of various soils, or land, are commonly recognized on the basis of farming experience. The range in productive capacity of different

soil types is readily apparent where the same crops are grown and the same general farming practices followed.

Differences in soil fertility may be inherent in the soil itself or may be related to past management practices such as crop rotations, fertilization, cultural practices and susceptibility and erosion. Soil fertility, it should be noted, is not the same as soil productivity, for an otherwise fertile soil may be limited by drainage or other such factors lessening production.

It is difficult to actually measure whether the fertility of soil is being maintained or not. It might be assumed that, if crop yields do not decrease, fertility is being maintained. However, the use of improved varieties of crops, better tillage methods and differing rates and methods of planting, may maintain or even increase yields without any increase in soil fertility.

Maintenance of soil fertility is more than just the application of fertilizer to the ground. It also includes build-up and maintenance of adequate organic matter, liming of acid soil and protection against erosion.

Organic matter levels may be increased or maintained by use of green manure crops, by application of barnyard manures and by working crop residues into the soil. Plenty of humus in the soil aids in improving soil structure and makes better use of commercial fertilizer.

Before application of commercial fertilizers, it is important that soil tests be made. Tests are used to determine the available supply of plant nutrient materials in the soil. Soil tests are a guide to the farmer in deciding the fertility needs of his soil; they must be accompanied by observation of crop conditions.

Soil sampling equipment and instructions may be obtained from the Agricultural Representative's office.

Department of Agriculture publication "Help yourself to a Soil Test" (Circular 181) gives complete information on taking soil samples.

(c) Erosion

Soil erosion has been an agricultural problem ever since man began to till the soil. In some parts of the world, erosion has destroyed great tracts of land for any sort of agriculture. Fortunately in Ontario most of our soils are not subject to such serious erosion as are for example some parts of the United States.

Soil erosion may be defined as "the movement of soil particles from one place to another by wind or water". Under natural conditions soil is covered with vegetation which retards run-off and slows down erosion. When land is cleared for cultivation the natural protective cover of vegetation is removed or reduced. Cultivation may change the structure of the soil and reduce organic matter. Such changes may easily produce, in a short time, a less productive soil.

Since man must till the soil to produce food, it is necessary to carefully fit the crop or the farming practice to the type of land being used. We must protect the soil in so far as possible by coming as close as we can to duplicating nature's protective measures to reduce erosion and run-off.

Factors Affecting Erosion

Of the several factors and practices contributing to soil erosion on any given piece of land, the most important is the physical character of the land itself. Soil texture, and length and amount of slope influence the amount of erosion that may take place. On top of this is the amount and time of rainfall and the cultural practices of the landowner.

Slope - The slope of the land, both in length and in steepness, has an affect on run-off and consequent erosion. The steeper the slope, the more rapid the run-off, and the greater its ability to erode the soil.

Steepness of slope is measured in per cent. A 5-per-cent slope means that that slope has a fall of 5 feet per 100 feet of length.

Rainfall - The character and pattern of rainfall over a watershed has a definite influence on erosion. Intense rainfall causes a larger immediate surface run-off than does a slow drizzle. It is these intense rains, usually lasting but a short time, that cause the greatest amount of erosion. Heavy spring rains, when the soil surface is soft, but the subsoil still frozen, are often particularly damaging.

Basically, the effect of rainfall on soil is the effect of the splash of the individual raindrop itself. A falling raindrop has tremendous power, and acts as a major erosion agent. When a drop hits bare soil it moves particles of earth. This action is multiplied billions of times in a heavy rainfall. Protective plant cover interrupts the falling raindrops, robbing them of their energy and easing them to the ground with little damage.

Use of the Land - Vegetation, whether leaves of trees or plants, litter of the forest floor, or sod cover, breaks the force of the rainfall. There is little or no run-off, and erosion is slight.

Rainfall on clean cultivated fields stirs up the unprotected soil, and there may be a great deal of run-off with subsequent erosion. Cultivation practices followed by the landowner have a great effect on the amount of run-off. Good sod cover will absorb rain rapidly and little is lost as surface run-off. A grain crop will give only partial protection to the soil. Row crops are little better than uncovered soil.

Cultivation up and down the slope, soil left bare over winter and the use of row crops on sloping land all contribute to water run-off and erosion on any given piece of land.

Types of Erosion

Erosion can be caused by either wind or water. In Ontario wind erosion is not usually a serious problem. However, extensive damage by wind erosion has occurred in some of the light sandy soils of the Oak Ridges moraine. This damage was once extensive in the headwaters of the Ganaraska River. Much of it is now controlled by reforestation and improved cultural methods. There are some localized spots of wind-eroded soil on the north side of the moraine in the Otonabee Watershed. For the most part, however, they are under control.

Water erosion can be divided into three types, - sheet, rill and gully, although there is no fine line of division.

Sheet erosion is the slow, persistent wearing away of the soil. It is the least spectacular form, and often proceeds unnoticed. It is the most common type of erosion in these watersheds. It is common on the slopes and tops of the drumlins.

Rill erosion is caused by water digging out small channels a few inches deep as it runs off sloping land. Rill erosion is common on fields in the spring.

Gully erosion occurs when water run-off is concentrated in channels that are unprotected. It is the most spectacular form of erosion. Fortunately there are few examples of gully erosion in these watersheds. Such gullies as were found during the conservation survey were mostly in Cavan Township; frequently they were caused by draw-back from existing ditches.

Effects of Soil Erosion

The effects of soil erosion will likely first be noticed on the fields from which the soil has been lost, but effects may be more general. Soil erosion causes silting and pollution of streams; it fills in ditches, and may clog up drainage systems. On rivers that flow into harbours, it silts up the harbours causing endless expense in dredging.

Loss of Topsoil - The loss of soil by any type of erosion means the loss of the most valuable portion of soil resources - the topsoil. This layer contains the humus and nutrients necessary for productive crop response. Potential yields are reduced, and so are the owner's profits. It is more difficult to grow good crops in subsoil and it is usually much less profitable. The effects of soil loss vary, of course, with the type of soil, and with the crop being grown.

Loss of Water - Water loss from the land is not a result of soil erosion, but the cause of it. Nevertheless, water loss from excess run-off is often more serious than erosion. Cultivation practices that decrease the possibility of soil erosion also decrease excessive water run-off. This is particularly important during the summer months when lack of moisture may be a limiting factor in crop yields. The more rainfall that can be absorbed into the soil in dry seasons, the greater amount will be available for plant growth.

Pollution - Much of the soil lost from the land eventually finds its way into stream courses and rivers. Many otherwise clear streams are polluted by soil wash. Such pollution, while not a health hazard, does affect fishing conditions in the streams; in some streams it can be a limiting factor. Silt blankets the stream beds and destroys many organisms that live there and provide food for the fish.

5. Conservation Measures

An important objective in good soil management is to protect soil from erosion and to hold as much as possible of the rainfall in a place where plants can effectively use it.

One of the goals of conservation farming is to keep soil losses as close as possible to the rate of loss in a natural landscape. It is usually impossible or impractical to use a farming system that will completely control soil losses. A farmer should be always aware, however, of the rate of soil

loss and depletion caused by his particular practices, and be ready to change or adjust them if it seems necessary.

A cover of vegetation is the first defence against erosion. Therefore a good soil management program will include an increasing quantity and quality of vegetative cover as the land use capability class falls from Class I to Class VIII. This cover may be in the form of permanent sod for pasture, or grassland strips alternated with cultivated land in strip-cropping or sod-covered channels for the safe run-off of excess water.

(a) Grassland

Grassland is hay or pasture. For years, many farmers regarded pasture as a second-rate crop. Fields not suited to cultivation were left to pasture. Usually no measures to improve them were taken. Today, many farmers are finding that an abundance of forage is the very foundation of profitable livestock farming.

The production and management of first-class pasture is not a simple job. It is often as difficult to produce good pasture as to grow grain or a cash crop. A peculiarity of grassland is that it is a combination of grasses and legumes, each with its own characteristics as far as fertility and soil requirements are concerned.

Grassland is of prime importance in controlling erosion and improving soil organic matter and soil moisture relationships. Grassland farming should be an integral part of the crop rotation system. Areas unsuited to cultivation should be put into permanent grass cover; other areas should have a sufficient proportion of grass to protect the soil and improve the production of cultivated crops.

Grasses and legumes provide organic matter for the soil and give it maximum protection against erosion. By improving soil structure and providing protection against the impact of the raindrop, water is dispersed. It is more easily

Contouring and strip cropping on this farm in South Monaghan Township, aid in reducing water run-off and soil loss on sloping land.

Alternating strips of grass and hay on a Smith Township farm.

This Class VI land on the Oak Ridges moraine in Cavan Township, is light and sandy. Tree cover is its best use.

able to enter the ground to the benefit of the crop and of the ground water supplies.

Advice on seed mixtures for permanent pastures renovating old ones or for controlling erosion can be obtained from the County Agricultural Representative, or other personnel of the Department of Agriculture or from a local seedsman.

(b) Grass Waterways

Grass or sod waterways are watercourses on sloping land. They may be natural or they may be man-made. Whatever their origin they are kept in permanent sod. Grass waterways are the most important single item in the control of water run-off from cultivated land for they are a means of conducting excess water safely from fields without allowing erosion to occur. They are a simple and effective erosion control measure that can be used by any farmer.

The best locations for waterways are usually the natural drainage ways of the landscape. In many cases these have always been left in sod, and should continue to be so. The simplest grass waterway is made by tripping cultivating implements as they cross a natural depression. In other instances waterways must be laid out and constructed in order to carry run-off safely.

When constructing a new waterway, it should be large enough to carry safely the heaviest rainfall anticipated in, say, a period of 10 years. A waterway should be broad and shallow; it should have a dense sod cover established on it as soon as possible. This sod cover should be maintained by regular fertilizing and, of course, it should never be broken up by cultivation.

Gullies are a symptom of land misuse, usually caused by cultivating too steep land or over-grazing it. Gullies often start in the banks of natural watercourses that have been cut to a considerable depth.

When still small, gullies can be shaped into grass waterways to prevent any further erosion. More serious

gullying will require more extensive, and usually expensive, treatment. This may involve mechanical measures such as small check dams, the planting of vegetation or trees to control erosion or the construction of diversion waterways to redirect the run-off water over another path, while the gully is being repaired.

There are many places where grassed waterways might well be used on farms in these watersheds. The rolling topography of Cavan Township, and the often steep-sided drumlins in other parts of the watershed will erode quite easily when subject to concentrated water run-off on cultivated fields. On most farms, grassed waterways can be easily and quite inexpensively constructed with the farmer's own equipment. In many localities municipal road maintenance equipment can be obtained for reasonable rental, and can be used to shape the watercourse.

(c) Contouring and Strip-Cropping

Strip-cropping is a system of growing crops in strips or bands laid out in a systematic manner as a barrier to erosion. The arrangement of crops in strips should be such that erosion-resistant crops, such as grasses, are alternated with clean cultivated crops which may be subject to erosion.

Contouring is the arrangement of the strips across the slope at right angles to the natural slope of the land. The best slopes for contouring are broad and smooth. Contour tillage is most effective on slopes of 2 per cent to 8 per cent, and not more than 300 feet long. Here the practice reduces soil losses to less than half that of up-and-down-hill cultivation. Satisfactory operation of strip-cropping may require the removal or relocation of fencelines. Most farms in this part of Ontario are laid out on a rectangular survey grid, hence fields are often not according to the "lay of the land", but fenced up and down the slope.

The main benefit of contouring and strip-cropping, is the reduction of soil and water losses. Another important benefit, however, is the greater ease and economy of farm operations. If strips are fairly long, there is less frequent turning, and power requirements are often reduced by "level" operation across the slope rather than up and down. One study showed savings of 13 per cent in time and 10 per cent in fuel when contour cultivation with power implements was substituted for up-and-down operation.

Contour cultivation, when used in combination with other good farming practices, effectively aids in conserving moisture. Small ridges and terraces formed by cross-slope cultivation act as small dams to retain water, and provide greater opportunity for its infiltration. In addition, the alternating sod strips slow down the water run-off and allow greater infiltration.

Sod strips alternated with cultivated land act as a barrier to water run-off from the cultivated strips. In some areas, particularly in tobacco-growing districts, sod strips are used as a barrier to wind erosion.

There are several farms in the area now using contouring and strip-cropping as a part of their soil management operations. This method of cultivation was recommended in their farm plan as a means of combatting the erosion problem on their sloping fields.

Advice and assistance on erosion control on cultivated land can be obtained through the Agricultural Representative from the Soils Specialists of the Ontario Agricultural College. He will be prepared to give assistance on laying out contours and strip-crops, grass waterways or the repairing of gullies.

(d) Woodland

Well-managed woodland plays an important part in any soil and water conservation program. It can help

Good buildings such as these reflect a prosperous farm on good quality land. This farm is near Mount Pleasant, in Cavan Township.

The ruins of this old barn near Warsaw on the Dummer moraine give evidence of the inability of this land to support agriculture.

# LAND USE CHANGES

## OTONABEE REGION CONSERVATION AUTHORITY

THESE TWO PHOTOS ARE OF AN AREA ON THE OAK RIDGES MORAINE, CAVAN TOWNSHIP, LOTS 5 TO 9, CONCESSIONS II AND III. THEY SHOW CHANGES IN LAND USE OVER A SIX YEAR PERIOD. THE TOP PHOTO, IN 1954, SHOWS MANY FIELDS LARGELY IDLE, OR ERODED, OR IN VERY POOR PASTURE. BELOW, THE SAME AREA IN 1960 SHOWS THAT MANY PORTIONS HAVE BEEN REFORESTED. MOST OF THE REMAINING LAND IS IN PASTURE.


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SCALE FEET

D.C.&D. CONSERVATION BR. B.A.E.

1961

protect the individual landowner from soil and water losses. Forestry is important in the overall picture of resource management on a watershed basis.

Forestry can be an integral part of many farm management plans. Most farms in these watersheds have some area of woodland on them. Many could have more.

Certain land classes, particularly Classes VI and VII, otherwise described as submarginal land, should be under forest cover. If already wooded, they should remain so; if not, reforestation may be needed.

Reforestation is an erosion control measure on steeply sloping fields or about the sides and head of gullies. In the upper part of the watershed there is land which should be kept under permanent vegetation, either grass or trees. Some of this land can best be used as pasture, with areas of forest cover on the steepest slopes.

Woodland around springs, or the source area of streams, will often aid in the regulating or restoring of flow. A farm plan may recommend that certain areas of woodland be set aside for wildlife cover.

(e) Farm Drainage

Soil drainage is essential to good soil management. The successful use of many acres of good farmland in Ontario is possible only because of artificial drainage.

Some of the benefits of soil drainage are (1) increased yield and improved quality of crops; (2) earlier planting is possible and hence a longer growing season. (3) Drainage may make low, wet areas available for grain or intertilled crops. Slopes, where the erosion hazard is higher, can be put in grass. (4) It permits the use of more regular crop rotations; (5) the controlled removal of excess water from soils can be an aid in combatting soil erosion.

Excess water can be removed by means of open ditches or by tile underdrains. In the area of this Authority,

there is little need for open ditch drains; most drainage will be by means of tile.

Whatever the area to be drained, it is well to have a survey made before starting. A survey plan will show the proper location of mains and laterals, location of outlets, grades, depths and number of tile required.

The Department of Agriculture, through its agricultural engineering fieldmen will, upon application, carry out a survey for drainage work. Applications and information may be had from the Agricultural Representative's office.

Bulletin 501, "Farm Drainage", by the Ontario Department of Agriculture, gives information on all types of drainage situations.

(f) Farm Ponds

An adequate supply of water is essential on any farm for livestock and household use. In many areas the need for water supplies is increasing. This increase is due to the much greater demands for water on many farms - demands caused by increased numbers of livestock, piped water supplies in house and barn, water for spraying and irrigation. On many farms, wells are not able to constantly supply this increased water demand.

Farm ponds can be an excellent source of water supply. They may be used as emergency or regular supply of livestock water. If near buildings, they offer fire protection. They can be of use for irrigation or spraying and, in addition, they have value for recreation, fish and wildlife.

A pond may get its water from surface run-off, springs or a permanently flowing stream. When designing a pond, its use and the water source should be kept in mind. To be successful, a pond must be properly located and properly constructed.

The Authority should publicize the necessity of adequate and proper construction of ponds and dams. It should

be emphasized that care must be taken in the building of dams, that spillway capacity should be adequate and emergency spillways always provided. Many small dams have failed because these precautions have not been taken. It should be noted that the permission of the Surveyor-General for the Province is required before any structure may be placed across a permanent stream.

Technical assistance on the location and design of farm ponds and dams is available from the Agricultural Engineering Extension Specialist of the Department of Agriculture.

# CHAPTER 6

## THE CAVAN BOG

### 1. Soils

#### (a) Location

Cavan bog, or swamp (it is locally called both) is located in the north-western part of the Otonabee River Watershed, in the upper part of Cavan Township in Durham County. It occupies parts of Concessions XI to XIII. Small parts of the bog are found in adjacent Emily and North Monaghan Townships.

#### (b) Reason for Survey

Bogs, swamps, marshes and other wetland areas are important land features of not only the Otonabee Watershed, but of most areas of the Province. Wetland areas may have value for wildlife, recreation, forestry and water conservation and flood control, and, if drained, sometimes for agriculture.

Although much is assumed little, unfortunately, is known about the actual condition and value of wetlands. For the purpose of collecting data on water, soil, forest and wildlife conditions in a wetland area, a detailed survey was made of Cavan bog. This particular wetland area was chosen because it was reasonably representative of wetland areas in the region, because of a certain amount of local interest in "the Bog", and also because of its accessibility and size. Cavan bog is only one of a number of wetland areas in these watersheds. Survey results and recommendation for this one will not necessarily apply to others in the region.

No previous surveys for which data are available have been done of Cavan bog. During the early 1950's some examination of the depth and character of the organic soils was made by commercial interests with the idea of using the area for agriculture. The plan however was never carried out.

The bog was examined during the summer of 1960 as part of the conservation survey of the watershed. The survey was designed to collect information on character and depths of

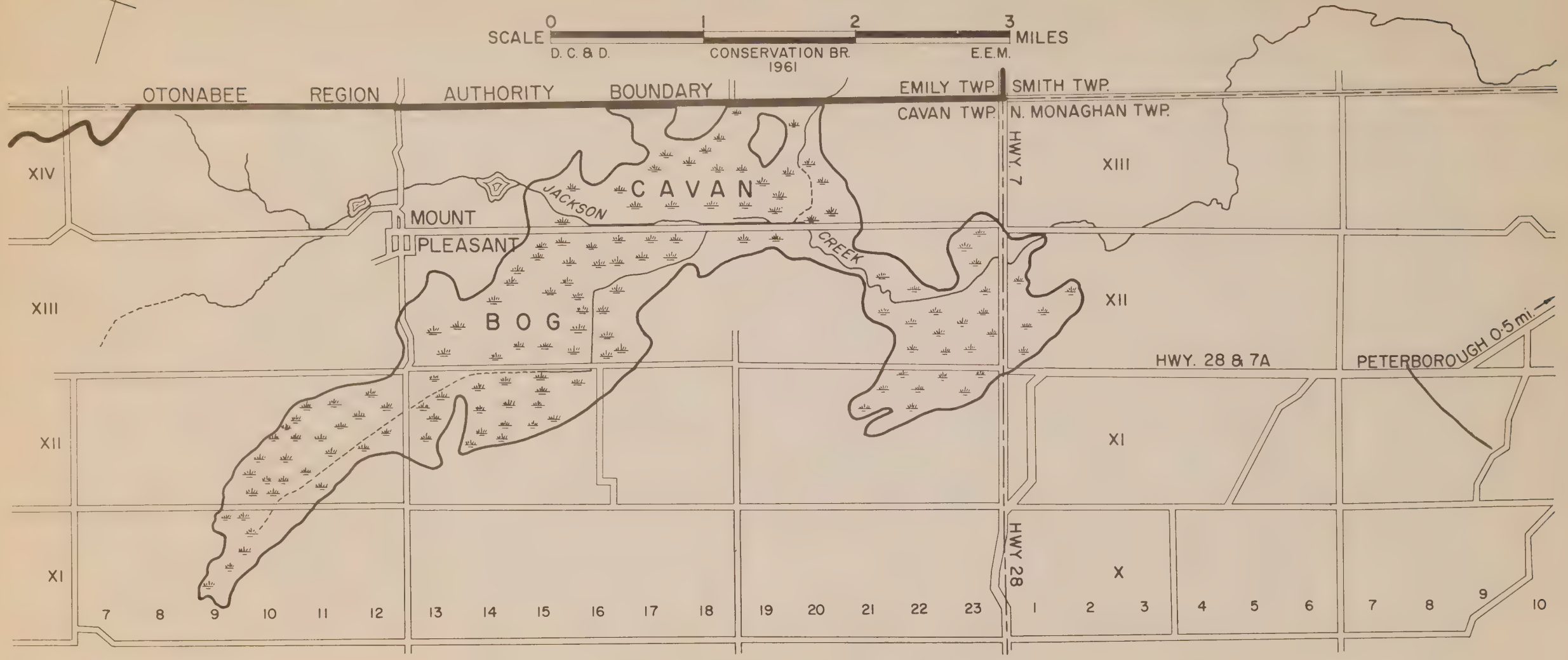
LOCATION MAP

SHOWING

# CAVAN BOG

IN THE

# OTONABEE REGION CONSERVATION AUTHORITY



organic soil deposits, the type and quality of forest growth, plant life, and some idea of water relationships.

(c) Soil Materials

The soil material in most wetland areas is of an organic nature which has reached varying stages of decay. The depth and quality of this organic deposit is of importance when any consideration is being given to the agricultural uses of bogs.

To carry out the soil material survey, specially constructed augers were used. With them, it was possible to secure samples of the soil material to 12-foot depths. A grid of sampling points for the whole bog was laid out at intervals of 1,000 feet by 600 feet. The depth of organic material was measured at each sample point, and recorded on an aerial photograph. Also observed was information on depth of well-decomposed muck, and type of material underlying the organic deposits.

Within the limits of the bog as defined for the survey, the organic material varied greatly in depth. This variation ranged from an inch or so down to auger depth of 12 feet, and with an apparent maximum of 15 feet. While the depth of actual sampling was limited to 12 feet, a few probes were made to greater depth. These probes indicated the probable maximum depth of peat to be not greater than 15 feet.

For the purposes of this report "peat" and "muck" may be defined as follows:

"Peat" - undecomposed, or only slightly decomposed organic matter, accumulated under conditions of excessive moisture.

"Muck" - highly, decomposed organic material, often mixed with a considerable amount of mineral material, finely divided, and so decomposed that the fibrous plant remains usually found in peat are no longer distinguishable.

There is a layer of muck over the peat. This layer varies from 2 inches to 6 inches in depth, averaging about 4 inches. The peat is often quite woody in composition. In some sections of the bog it was difficult to sink the auger in more than a few inches without encountering buried woody

# CAVAN BOG

SHOWING DEPTH OF MUCK AND/OR PEAT

SCALE IN FEET

1320 660 0 1320 2640 3960 1 mile 5280

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materials. The colour of the peat varies from dark to light brown. In deeper deposits it gives off a noticeable odour of hydrogen sulphide ("rotten eggs") gas. This is a result of decomposition processes.

The reaction of the peat is neutral to very slightly acid.

The mineral soil underlying the peat is variable in type, being composed in different parts of the bog of either marl, clays or coarse sand. Marl is a soft earthy deposit consisting chiefly of limestone mixed with sand, clay or organic materials. It contains many small shells. Marl commonly underlies those sections of the bog where the peat deposits are deepest.

Cavan bog occupies the site of an ancient glacial lake. Glacial Lake Jackson was created by ice blocking a drainage course during the last ice advance. With the disappearance of the ice and the coming of growth thousands of years of vegetation have crowded in on the shore of the lake, died and sunk to the bottom and gradually built up the deposits of organic material. Each season growth spread further into the water from the shoreline until eventually the bog was formed.

## 2. Forestry

### (a) Introduction

From the forestry point of view the Cavan bog area must constitute not only the large wet muck area of up to 3,000 acres, but an all-important fringe area which ranges uphill from the swamp proper. This fringe area has an "elastic" boundary, caused by past use of the surrounding farmland. Therefore the boundary of the fringe areas does not run continually and exactly parallel to the edge of the muck section.

Species content of the Cavan bog forest ranges from the wet lowland cover types to the dry upland types. At present the latter exhibits the greatest potential for quality timber.

(b) Past Use

At least one sawmill has operated off the Cavan bog since the turn of the century, or for at least fifty years, receiving the bulk of its material from the swamp forest. Its principal timber was in the form of elm and black ash, which was cut into lumber for furniture production. During this fifty-year period the supply gradually dwindled until, over the last 10 years, the mill became dependent on local custom sawing for its business. This supply also became too sporadic for profitable operation and the mill closed down two years ago.

However, use of the bog for forest products has continued. There is ample evidence of clear cutting in patches, mostly for firewood and fence posts. Here again the fringe forest has been affected on a continuous basis. No individual control of cutting methods appears to have been employed.

Considerable influence has been exerted on forest succession within the bog by cattle grazing. This has been detrimental since it has tended to remove valuable species such as maple from dry fringe areas.

It can be seen therefore that where human agencies have found sufficient footing to work on the "bog" forest the best timber has been removed, to be succeeded by the middle class timber, which has also been sporadically cut as it could be used. Each time the succession has tended to grow into a lower form of forest. Throughout the process, cattle grazing has increased the loss of the succulent, more valuable species produced by regeneration. The final result could only be a Cavan bog forest reduced to its lowest form.

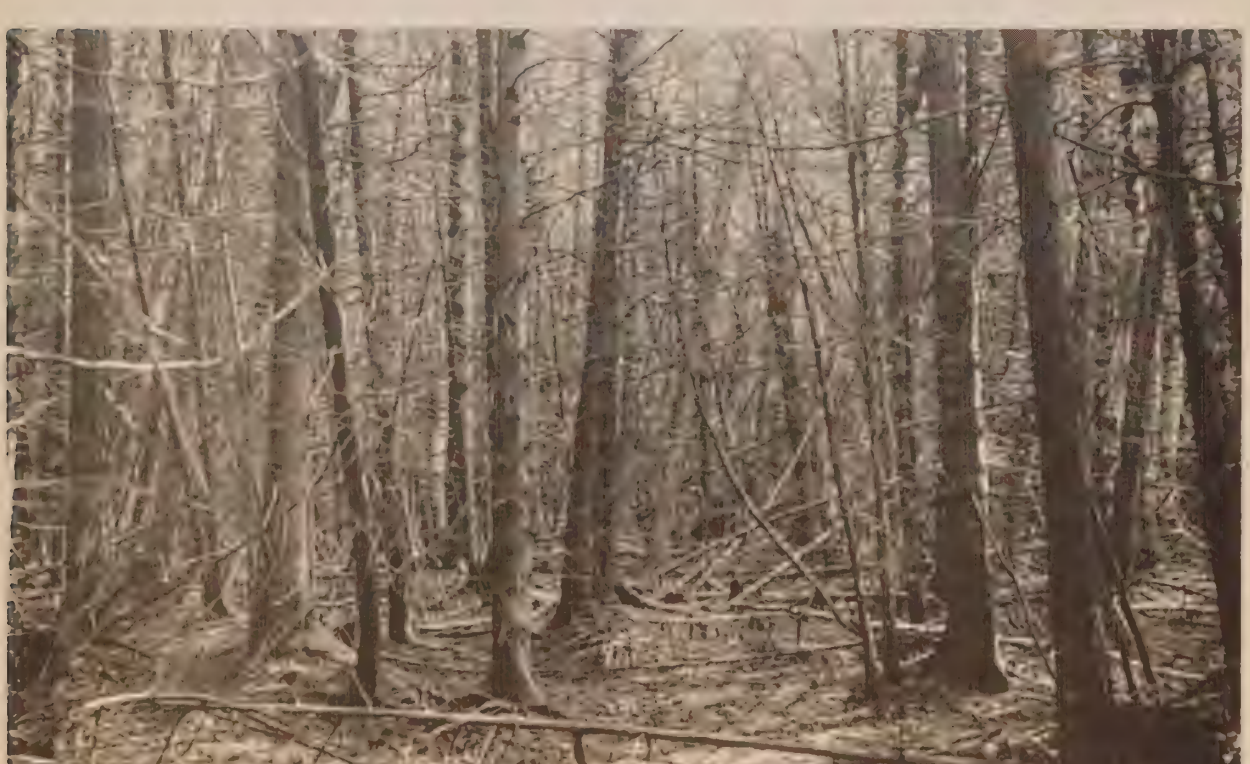
(c) Species Content

(1) Main Bog Forests

Generally speaking, the forest cover types within the main body of the Cavan bog are an amorphous mixture of intermingling species combinations adapted to a moist site. This is in contrast to the normal marsh or wet-site forest.

The wooded nature of Cavan Bog is shown in this view.

This second growth poplar with some ground cover in the bog has little forest value.



Second growth cedar with no ground cover is typical of parts of Cavan Bog.

Although many species are represented, the key species in order are:-

1. Balsam poplar and the aspens
2. White elm
3. White cedar
4. Tamarack
5. Black ash
6. Black spruce
7. Balsam fir

The presence of the odd individual of other representative species also adds considerably to this list.

Tamarack as a cover type and with other inclusive species, occupies large areas of the west or southwestern section and a portion of the eastern section of the bog. In the central or main body of the bog it becomes a patchy constituent of the forest. The tamarack cover type is rarely heavily stocked.

The main body of the bog contains large portions of either poplar or elm as a cover type. Because each of these two species is a principal constituent of both cover types*, the boundary between type 4 (poplar) and type 60a (elm) must be considered arbitrary. Both cover types exhibit a good percentage of average and heavy stocking. Where both cover types are situated on a wet site, a substory of variably aged black ash will appear.

Amid the ranges of tamarack to elm and poplar types, one will encounter patch cover types of white cedar, each of which will have inclusions of black spruce and a small amount of balsam fir. Because isolated poplar and elm trees appear in these cover types (type 24), their definition as a pure conifer or mixedwood is also arbitrary.

Two other conditions are common in the cedar areas of the bog. Clear cutting of sections of a cedar cover type tend to cause "blowdown" of any of the remaining stand, and the piling of large amounts of coniferous "slash" over

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* See Forestry Section of Report for explanation of cover types.

openings on the forest floor seriously inhibits the subsequent growth of coniferous regeneration and promotes a succession to a less desirable poplar coppice.

(2) The Fringe Forest

This forest exhibits no consistent cover type trend. There are areas of maple, beech, pine, hemlock and other admixtures. Because of the greater ease of operation as compared to the swamp forest proper, woodlots that have not been intelligently cared for are opening up, becoming weedy and are succeeding to species of much lesser value. Again, local grazing methods are aiding the depreciation process.

On the north side near the town line there is one block of woods which was allowed to become over-mature so that valuable yellow birch, hemlock and basswood logs have been lost due to windthrow. Small sections of overgrazed second growth coppice are also common.

Conclusions

If it were reserved as a block of the proposed Otonabee Authority Forest, the Cavan bog would have certain benefits:

1. By providing long-term cover, the preservation of a valuable water-source area will be aided.
2. Being under the control of one agency, exploitation of the bog can be done with moderation over a longer period of time.
3. If experimentation is needed to discover sounder harvesting techniques in swamp forest, such experiment can be performed without damage to the over-all larger stand. The owner of a small property cannot do this, as a harvesting experiment may use up too high a percentage of his holding.
4. Its present species composition can be gradually changed to one of greater over-all use and therefore of higher value.

Recommendation

That 2,500 acres of the Cavan bog be acquired as part of the Otonabee Region Conservation Authority Forest. These areas are illustrated on the recommended Authority

Forest map in the Forestry section of the Otonabee Region Conservation Authority report.

List of properties recommended for acquisition as Authority Forest in the Cavan bog.

| Concession | Lot Descriptions | Acres |
|---|---|---|
| 12 | N½ Lots 12, 13, 14 and 15 | 400 |
| 12 | All of Lot 11 | 200 |
| 12 | S½ Lots 9 and 10 | 200 |
| 13 | S½ Lots 13, 14 and 22 | 300 |
| 13 | All of Lots 15, 16 and 23 | 600 |
| 14 | S½ Lots 15, 16, 17 and 18 | 400 |
| | All of Lots 19 and 20 | 400 |
| | | 2,500 |

3. Wildlife and Wild Plants

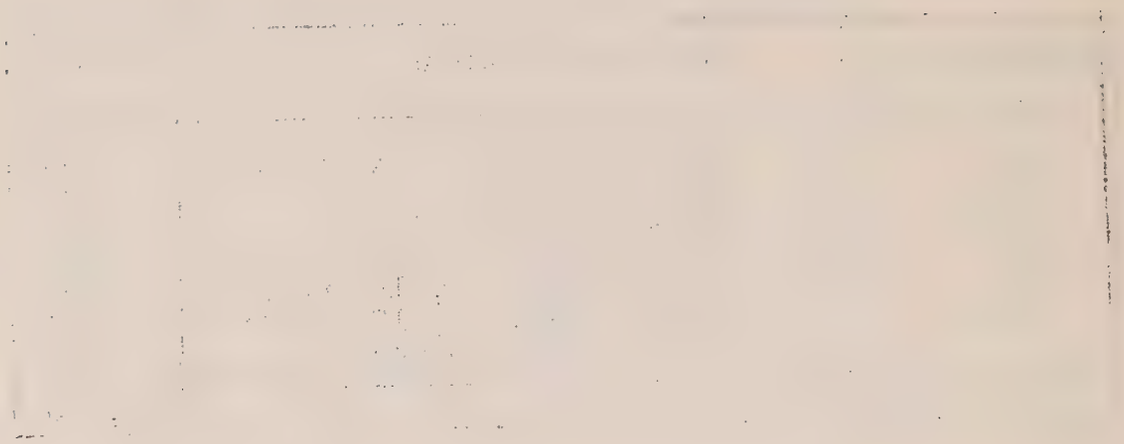
Bogs and swamps in Southern Ontario vary greatly in their soil and water conditions, and hence vary greatly both in their capacity to attract and harbour wildlife and in their ability to produce unusual and interesting vegetation.

The soils of this bog and the major forest types have already been described in this report. The following summary describes only the habitat for wildlife of the bog in the summer of 1960, the animals which are believed to be present, and most of the more interesting wild plants which are known to be present.

(a) Birds

(1) Game Birds

It is extremely unlikely that waterfowl would make any extensive use of the limited water areas in the Cavan bog. No doubt Black Ducks, Mallards and Blue-winged Teal occasionally use the pond near Mount Pleasant, and no doubt they use the streams in the Cavan bog at times. Wood Ducks might use some of the few small ponds, but this seems unlikely, as larger bodies of water with nearby nesting-holes in poles or trees would be much more attractive. The Ruffed Grouse is not an



uncommon species. When in an isolated area, such as this one is, it is possible that the species is not cyclic in numbers. Pheasants do not appear to have survived the several introductions. Many edges of the swamp make ideal grounds for the American Woodcock, which is undoubtedly present. The Common Snipe can be expected to occur rarely in several of the more open sedge meadows.

(2) Bird List

The following list includes 99 species which, from the evidence of their presence in Peterborough County, and from the nature of the Cavan bog and the adjacent meadowland, may be expected at some time of the year in the area of the Cavan bog. Some of these will of course be seen only in migration. Very rare species are not included.

American Bittern
Turkey Vulture
Sharp-shinned Hawk
Cooper's Hawk
Red-tailed Hawk
Red-shouldered Hawk
Broad-winged Hawk
American rough-legged Hawk
Marsh Hawk
Sparrow Hawk
Ruffed Grouse
American Woodcock
Common Snipe
Mourning Dove
Black-billed Cuckoo
Screech Owl
Great Horned Owl
Barred Owl
Whip-poor-Will
Ruby-throated Hummingbird
Belted Kingfisher
Yellow-shafted Flicker
Pileated Woodpecker
Yellow-bellied Sapsucker
Hairy Woodpecker
Downy Woodpecker
Arctic Three-toed Woodpecker
American Three-toed Woodpecker
Eastern Kingbird
Crested Flycatcher
Eastern Phoebe
Least Flycatcher
Eastern Wood Pewee
Tree Swallow
Bank Swallow
Rough-winged Swallow
Barn Swallow
Blue Jay
Crow
Black-capped Chickadee
White-breasted Nuthatch
Red-breasted Nuthatch
Brown Creeper
House Wren
Long-billed Marsh Wren
Short-billed Marsh Wren
Catbird
Brown Thrasher
Robin
Wood Thrush
Hermit Thrush
Veery
Golden-crowned Kinglet
Ruby-crowned Kinglet
Cedar Waxwing
Northern Shrike
Loggerhead Shrike
Starling
Red-eyed Vireo
Warbling Vireo
Black-and-white Warbler
Nashville Warbler
Yellow Warbler
Magnolia Warbler
Myrtle Warbler
Black-throated Green Warbler
Blackburnian Warbler
Chestnut-sided Warbler
Bay-breasted Warbler
Pine Warbler
Oven-bird
Northern Waterthrush
Yellowthroat
Canada Warbler
American Redstart
House Sparrow
Bobolink
Meadowlark

Red-Wing
Baltimore Oriole
Grackle
Cowbird
Scarlet Tanager
Indigo Bunting
Evening Grosbeak
Purple Finch
Pine Grosbeak
Common Redpoll
Pine Siskin
Common Goldfinch
Vesper Sparrow
Slate-coloured Junco
Tree Sparrow
Chipping Sparrow
White-crowned Sparrow
White-throated Sparrow
Swamp Sparrow
Song Sparrow
Snow Bunting

(b) Mammals

Game and Fur

The following species of game and fur-bearers are present in the Cavan bog.

| | |
|---|---|
| WHITE-TAILED DEER | A common species. However, it should be noted that there has not been an open season for deer in Durham County, which includes Cavan Township, in recent years. |
| BRUSH WOLF | The brush wolf may be expected to occur in the Cavan bog, although it is seldom seen. |
| RACCOON<br>SKUNK<br>BEAVER | There are several colonies of beaver and several new beaver dams were seen during the survey. |
| MUSKRAT | Muskrat burrows are common along Jackson Creek. |
| MINK | Tracks were seen on several occasions along Jackson Creek. |
| SNOW SHOE HARE | The area is well within the range of the snow shoe hare, but none were seen on the survey. |
| COTTONTAIL | This species is common on the fringes of the bog. |

Other Species

| | |
|---|---|
| PORCUPINE | The porcupine, which cannot be classified as either game or fur, is an interesting species but one which does considerable damage to coniferous tree species and often requires control in plantations or woodlots. |

Besides the above species, there are probably five species of shrews, two species of moles, six species of bats, four species of squirrels and eight species of mice, which may all be expected in the Cavan bog. Additional possible species include the otter and the bobcat, which might at times frequent this bog.

(c) Wild Plants of the Cavan Bog

The flora of the Cavan bog has long been known to be of exceptional interest to botanists, and to a lesser degree, to the general public. So far as is known, no systematic intensive study of the flora of the bog has been made by professional botanists. However, many entirely capable amateur botanists, chiefly members of the Peterborough Nature Club, have examined and photographed the rare species known to be in the bog.

It is impossible to say how much change there has been in the water conditions, the soil conditions or the resulting vegetation as a result of the cutting of timber species, principally elm and black ash, for lumber during the last century. There has been some clear cutting and occasional grazing. The ground vegetation must in some areas, have been radically changed. More than eight miles of roads and cleared road-allowances pass across the bog, and at least three drainage ditches have been dug. These of course, have had some effect on the vegetation and water levels.

The extent of sphagnum bog (which is frequently found in association with tamarack and black spruce) was not measured on the summer survey, but there are several areas of sphagnum in the south-eastern section of the bog and small scattered patches elsewhere.

The following list of flora is of course not a complete one, since it does not include the hundreds of species of grasses and sedges and other relatively uninteresting plants.

The late Frank Morris*, first drew attention to the unusual varieties of orchids which grew in the Cavan bog. However, he was careful not to mention the exact localities or stations for the rare species.

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* Morris, Frank; and Edward Eames, "Our Wild Orchids", Scribners, 1929.

## LIST OF ORCHIDS FOUND IN THE CAVAN BOG

| | |
|---|---|
| Cypripedium arietinum | Ram's Head Lady's Slipper |
| " pubescens | Large Yellow " " |
| " parviflorum | Small Yellow " " |
| " reginae | Queen " " |
| " acaule | Stemless " " |
| Habenaria hyperborea | Tall Northern Green Orchid |
| " dilatata | Tall White Bog Orchid |
| Orchis rotundifolia | Small Round-leaved Orchis |
| Pogonia ophioglossoides | Rose Pogonia |
| Calopogon pulchellus | Calopogon |
| Spiranthes cernua | Nodding Lady's Tresses |
| Spiranthes Romanzoffiana | Hooded Lady's Tresses |
| Arethusa bulbosa | The Arethusa Orchid |
| Malaxis unifolia | Green Adders Mouth |
| Corallorhiza striata | Striped Coral Root |
| " maculata | Spotted " " |
| " trifida | Early " " |
| Habenaria clavellata | Green Wood Orchid |
| " obtusata | Blunt-leaved rein orchid |
| Malaxis monophyllus | White Adder's Mouth |

## PARTIAL LIST OF OTHER FLOWERS IN THE CAVAN BOG

| | |
|---|---|
| Sarracenia purpurea | Pitcher Plant |
| Kalmia polifolia | Swamp Laurel |
| Lobelia Kalmii | Kalm's Lobelia |
| Trientalis borealis | Star Flower |
| Cornus canadensis | Bunchberry |
| Ledum groelandicum | Labrador Tea |
| Moneses uniflora | One-flowered Pyrola |
| Andromeda glaucophylla | Bog Rosemary |
| Pyrola elliptica | Shinleaf |
| Pyrola rotundifolia | Wild Lily-of-the Valley |
| Mianthemum canadense | False " " " " |
| Eriophorum opacum | Cotton Grass |
| Iris versicolor | Blue Flag |
| Clintonia borealis | Clintonia |
| Linnaea americana | Twinflower |
| Vaccinium oxycoccus | Small Cranberry |
| Mitchella repens | Partridge Berry |
| Senecio aureus | Golden Ragwort |
| Valerian Sylvatica | Valerian |
| Tiarella cordifolia | Foam Flower |
| Mitella diphylla | Bishop's-Cap Miterwort |
| Mitella nuda | Naked Miterwort |
| Menyanthes trifoliata | Buckbean |
| Utricularia cornuta | Yellow Bladderwort |
| Potentilla argentea | Silvery Cinquefoil |
| Viola canadensis | Canada Violet |
| Viola blanda | Sweet White Violet |
| Viola cucullata | Marsh Violet |
| Viola rostrata | Long-spurred Violet |
| Aronia melanocarpa | Black Chokeberry |
| Typha latifolia | Broad-leaved Cat-tail |
| Arisaema triphyllum | Jack-in-the-pulpit |
| Oenothera biennis | Evening Primrose |
| Eupatorium purpureum | Joe-pye Weed |
| Asclepias syriaca | Milkweed |
| Claytonia caroliniana | Wide-leaved Spring Beauty |
| Cerastium arvense | Chickweed |
| Circaea canadensis | Enchanter's Nightshade |
| Solanum dulcamara | Bittersweet |
| Aquilegia canadensis | Wild Columbine |
| Clematis Virginiana | Wild Clematis |
| Echinocystis lobata | Wild Cucumber |
| Hypericum perforatum | Common St. John's-Wort |
| Anemone canadensis | Anemone |
| Ranunculus septentrionalis | Marsh Buttercup |

| | |
|---|---|
| Thalictrum dioicum | Early Meadow Rue |
| Thalictrum polygamum | Fall Meadow Rue |
| Spiraea tomentosa | Hardhack or Steeplebush |
| Fragaria virginiana | Wild Strawberry |
| Fragaria vesca | Wood Strawberry |
| Geum strictum | Yellow Avens |
| Geum rivale | Water Avens (Purple) |
| Geranium robertianum | Herb Robert |
| Gerianum maculatum | Wild Geranium |
| Impatiens biflora | Jewelweed |
| Apocynum androsaemifolium | Spreading Dogbane |
| Prunella vulgaris | Self-Heal |
| Hieracium aurantiacum | Orange Hawkweed |
| Galium asprellum | Rough Bedstraw |
| Anaphalis margaritacea | Pearly Everlasting |
| Erythronium americanum | Yellow Dog's-tooth Violet |
| Myosotis scorpioides | Forget-me-not |
| Achillea millefolium | Yarrow |
| Sium pusilla | Water-parsnip |
| Drosera rotundifolia | Round leaved Sundew |
| Caltha palustris | Marsh Marigold |
| Coptis groenlandica | Goldthread |

There are also at least forty-four species of trees and shrubs in the Cavan bog, including such unusual and interesting species as the northern dwarf birch, mountain holly, nannyberry and highbush cranberry.

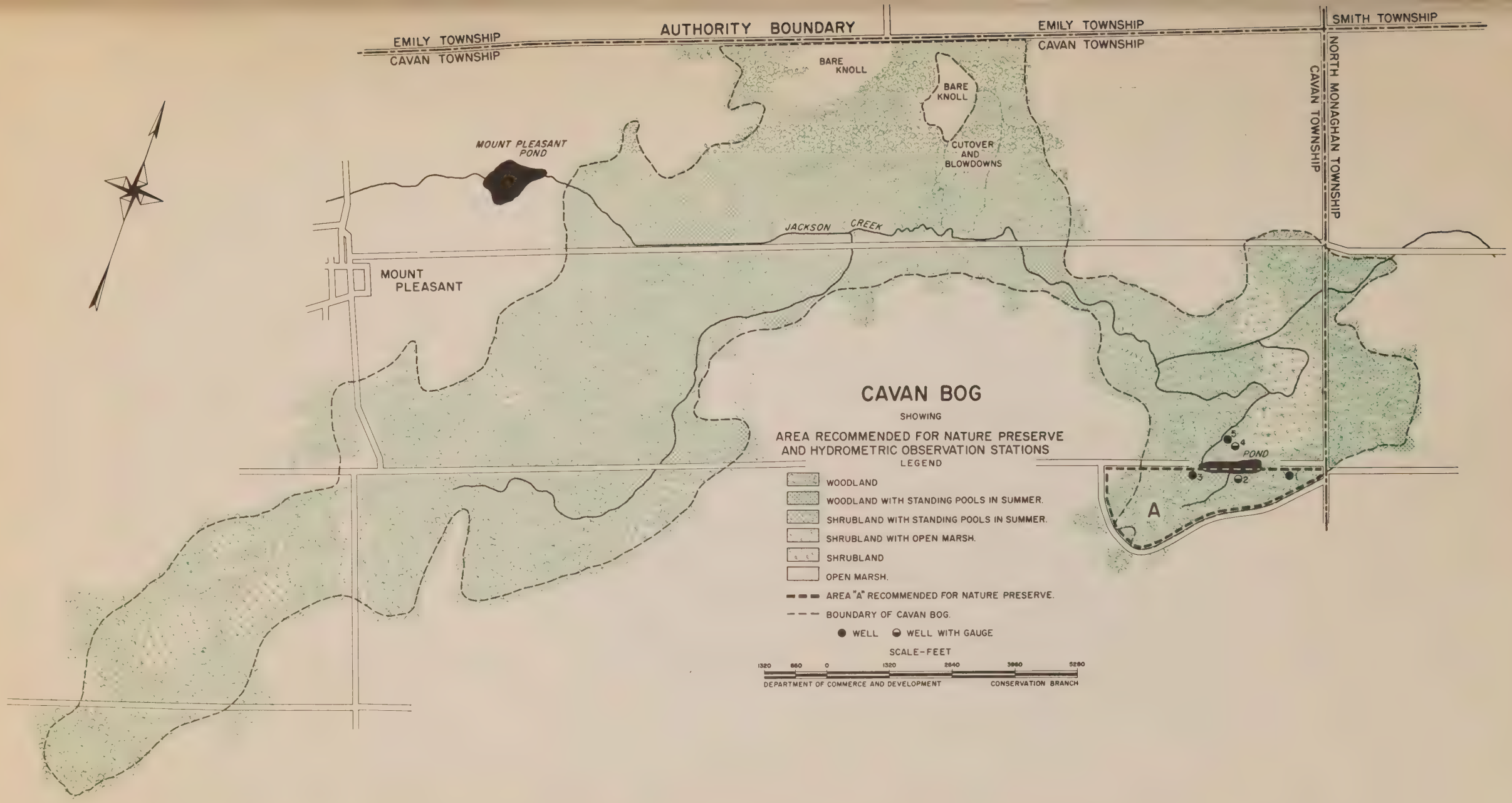
Almost all of the species mentioned can be found in the south-east lobe of the main Cavan bog. This area, approximately 340 acres in extent, is a unique mixture of marsh, wet woodland, sphagnum bog and quaking bog.

A careful appraisal of the above lists shows that, while the birds and mammals of the Cavan bog are those which would be expected to occur in such an area, the wild plants, and particularly the orchids, form a very remarkable collection and one which probably cannot be duplicated in such a small area anywhere in the province. Where rare plants are concerned, there is always a question as to whether it is a disadvantage to draw the attention of the public to the location, through its acquisition by a public body, or to leave the area under its present ownership; and thus to leave the general public unaware of the location, and therefore less likely to disturb it. However, almost all of those who are interested in rare and unusual plants, already know of this bog. It therefore appears to be in the public interest that the area should be in

Only a small part of Cavan Bog can be described as a "quaking" bog. Plants typical of such wet conditions are found.

The tall, white bog-orchid (Habenaria dilatata, Pursh.) is found in the area.

Measuring the depth of one of the few patches of open water in the bog.


AUTHORITY BOUNDARY
EMILY TOWNSHIP
CAVAN TOWNSHIP
EMILY TOWNSHIP
CAVAN TOWNSHIP
SMITH TOWNSHIP
NORTH MONAGHAN TOWNSHIP
CAVAN TOWNSHIP
BARE KNOLL
BARE KNOLL
CUTOVER AND BLOWDOWNS
MOUNT PLEASANT POND
JACKSON CREEK
MOUNT PLEASANT
POND
A
CAVAN BOG
SHOWING
AREA RECOMMENDED FOR NATURE PRESERVE AND HYDROMETRIC OBSERVATION STATIONS
LEGEND
WOODLAND
WOODLAND WITH STANDING POOLS IN SUMMER.
SHRUBLAND WITH STANDING POOLS IN SUMMER.
SHRUBLAND WITH OPEN MARSH.
SHRUBLAND
OPEN MARSH.
AREA "A" RECOMMENDED FOR NATURE PRESERVE.
BOUNDARY OF CAVAN BOG.
WELL
WELL WITH GAUGE
SCALE-FEET
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DEPARTMENT OF COMMERCE AND DEVELOPMENT
CONSERVATION BRANCH

public hands. The following recommendation is therefore made, and is adjusted to complement the recommendations in the Forestry section of this report.

Recommendation

It will be noted that in the Forestry Report on the Cavan bog, all of Lot 23 and the south half of Lot 22 of Concession XIII are recommended for acquisition as Authority Forest. There are many unusual species of plants in this particular area but it appears from the survey, and from observations made by members of the Peterborough Nature Club that the area of the bog in Concession XII (north of the new road which skirts the bog) is of even greater importance botanically. It is therefore, recommended that this southern section should be acquired by the Conservation Authority as a Nature Reserve or Conservation Area, quite separate from those areas useful for agriculture or forestry. The recommended area is shown on the accompanying map.

In this particular case, the importance of leaving the area undisturbed would seem to outweigh the importance of its management for forestry purposes. Too great a disturbance of the forest cover now on the area might easily result in a serious blow-down condition.

4. Water-Balance Study

A pilot study on the water-balance of Cavan bog was undertaken during the summer of 1960 to obtain information on water consumption and loss from the swamp, and as a means of examining the problems involved in observational procedure and instrumentation for such a study.

The variations of the water-table in a swamp are an integration of the complex relationship between precipitation, evaporation, transpiration, run-off and seepage. While each of these items plays an important role in the water-balance

On the man's left is a plastic rain gauge, and to his right, a pipe to measure ground water levels in the Cavan Bog.

Measuring depths of organic deposits with a special auger in the Cavan Bog.

of the swamp, the individual effect of each item is extremely difficult to assess. It was felt that by establishing a project even on a limited basis, it would be possible to obtain an indication of the quantities of water lost from the swamp and the necessary instruments for the observations.

From late in June, through summer and fall, rainfall amounts and the height of the water-table were recorded at twice weekly intervals in the south-west corner of Cavan bog, over an area of about 100 acres (Fig.1). These data are plotted on the accompanying chart (Fig.2).

The study area was located adjacent to the pond on the submerged section of the concession road, between Concessions XII and XIII, Cavan Township, at Lot 22. Well No.2 was only 40 feet from the pond, while the other four wells ranged from 150 feet to 800 feet away. (see Fig.1 and picture of observation site).

The ground cover over the study area was primarily cedar, with dogwood and other shrubs in the more open sections. The depth of the peat varied from 12 to 15 feet. More detailed descriptions of the ground cover and soil types are given in the sections of the Cavan bog report, dealing with these features.

(a) Instrumentation

The wells consisted of 3-foot lengths of 6-inch diameter metal stove pipe set down 2½ feet into the peat. The pipes were perforated throughout their length, and care was taken to ensure that the peat around the pipe was not disturbed any more than necessary to insert the pipe. The depth of the water-table was measured with a ruler from the top of the well-pipe.

As a means of checking on the stability of the well casing through the season, 12-foot metal posts were driven down the centre of wells No.2 and No.4, until the tops

of the posts were level with the top of the well-pipe. No apparent changes in level were noted during the period of observation.

Two wedge-shaped plastic rain gauges were installed at wells No.2 and No.4, as a means of sampling the rainfall over the area. Differences in amounts between the two gauges were very small.

A plywood weir was installed near well No.5 in the small watercourse which drains the pond on the concession road. The soil, however, was unsuitable for a structure of this type, and a washout occurred before measurements of the discharge could be taken.

(b) Results

The well records for wells No.1, 3, 4 and 5, showed a marked similarity in pattern. Consequently only the plot for one of these, well No.4, is shown in Fig.2. Well No.2, being close to the pond, did not show as great a change as the other wells and is, therefore, shown on the chart.

The rainfall amounts shown on the chart, were obtained from the twice-weekly readings, and apportioned on the basis of daily rainfall observations, taken at two sites in Peterborough.

A few water-level readings were taken in October, November and early December, after the survey party had left the area. The rainfall at Peterborough was plotted for this period, to indicate the pattern over the area.

The rainfall over the swamp for the period, June 20 to September 30, was 4.6 inches, occurring in amounts of 3/10 to 5/10 inch at 3- to 5-day intervals, in the latter part of July and through August.

The water-table showed a general downward trend, from the beginning of observations, until the lowest level was reached in the third week in September. The affect on the water-table of rains of 0.4 inch or more, is quite noticeable.

It must be pointed out, however, that the total volume of water causing these rises in the water-table, may be quite considerably more than the indicated rainfall over the swamp, as the swamp is surrounded by drumlins, which extend the area of the watershed beyond the boundary of the swamp soil.

In the period June 20 to September 22, the total rainfall was 4.3 inches and the total drop in water-table averaged over the five wells was 19 inches. If it is assumed that the water-table in the swamp changes 6 inches for 1 inch of rain, as was found in Bradford Marsh*, the decrease in the water-table would be a water loss and consumption of 3.2 inches. This would be a total loss of water from the swamp of approximately 7.5 inches. In view however of the extended area of the swamp watershed, the water consumption and loss from the swamp by evapo-transpiration, run-off and seepage computed on drainage from the whole basin, is no doubt much greater than 7.5 inches.

Rainfall of about 1 inch at the end of September and beginning of October caused a slight recovery in the water-level. During the next three weeks of October, in which no rain occurred, there was little or no change in the water-level. This would indicate that evapo-transpiration at this period of the year is at a very low level in comparison with rates prevailing during the summer months.

The water-levels began to climb in early November as a result of rains, levelling off at a few inches below the near capacity values which prevailed at the beginning of the study period in late June.

(c) Rainfall Records

The climatic pattern of a region is an important factor in assessing the results of water-balance studies. In

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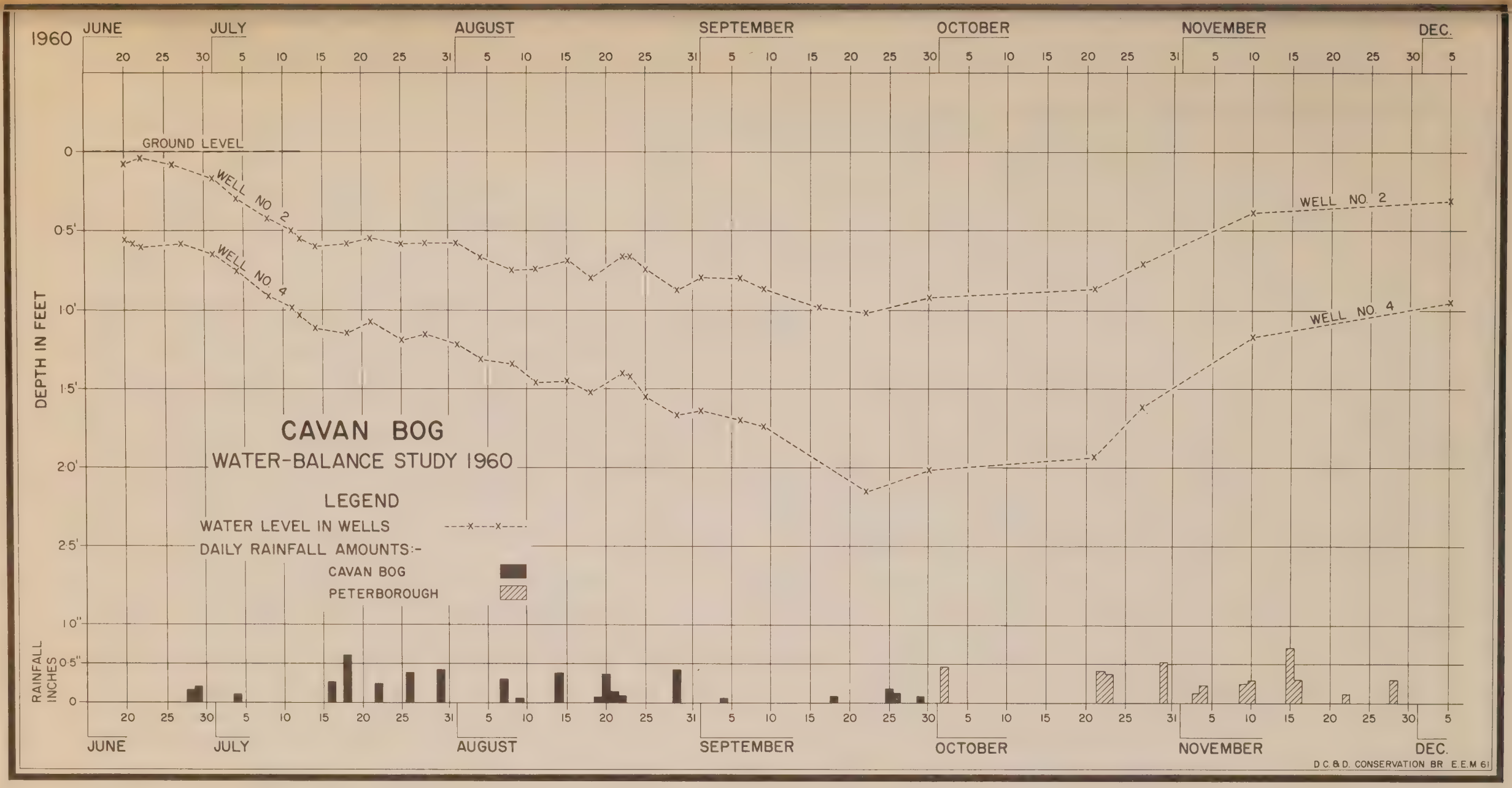
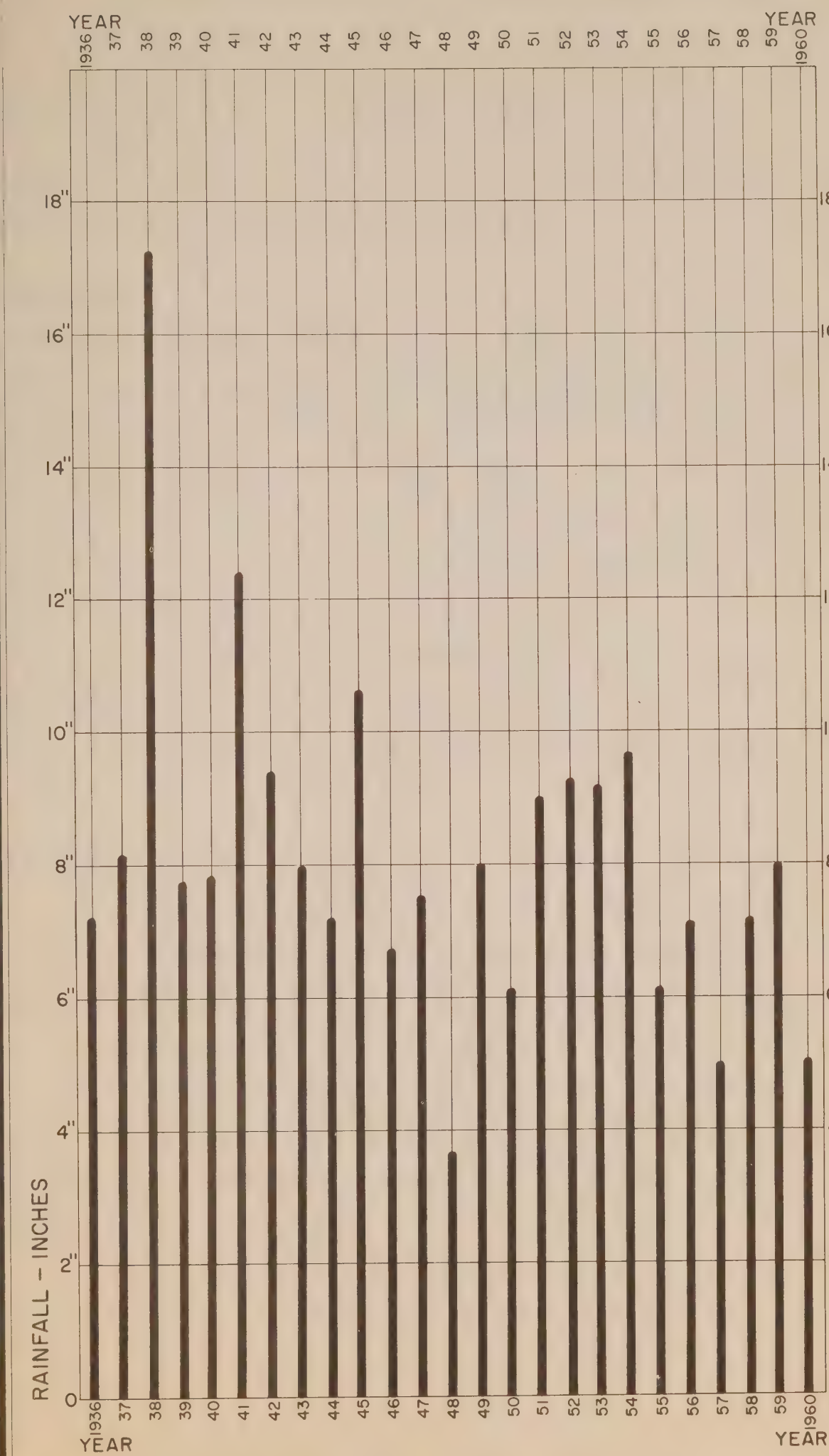
* Personal communication, L.J. Chapman, Ontario Research Council.


1960
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DEC.
GROUND LEVEL
WELL NO. 2
WELL NO. 4
DEPTH IN FEET
0
0·5'
1·0'
1·5'
2·0'
2·5'
CAVAN BOG
WATER-BALANCE STUDY 1960
LEGEND
WATER LEVEL IN WELLS
DAILY RAINFALL AMOUNTS:-
CAVAN BOG
PETERBOROUGH
RAINFALL INCHES
1·0"
0·5"
0
D.C.& D. CONSERVATION BR E.E.M 61

# RAINFALL AT PETERBOROUGH
## FOR THREE MONTH PERIOD
## JULY, AUGUST, SEPTEMBER




D. C. & D. CONSERVATION BR. E. E. M. 61

order to correlate the 1960 data with general conditions for the area, a review was made of the rainfall amounts at Peterborough for the three months, July, August, September, during the past 25 years, 1936-1960 (Fig.3). The average for this period is 7.8 inches, with a range of 13.6 inches from a low of 3.7 inches in 1948 to a high of 17.3 in 1938. The 1960 amount of 5.0 inches is, along with 1957, the second lowest reading indicating an abnormally dry year.

Conclusions

Limited observations of rainfall and water-level during one summer in a small section of Cavan bog, cannot be expected to supply definitive results on the water-balance of the area. The data however would suggest that the loss of water from the swamp through evapo-transpiration, run-off and seepage, can in dry years be of considerable magnitude in relation to the available water supply.

A more detailed observational program and instrument network than that undertaken in this pilot study is necessary, if specific data are required on the water-balance of swamps.

Recommendations

A detailed knowledge of the water-balance of swamps must be obtained, before a comprehensive watershed management plan can be fully established on the many river basins of Southern Ontario in which swamps are a major feature of the physiography. This study has indicated that factual results are obtainable only through an extensive and well-instrumented observational program, operated without interruption over a period of years.

Research into the water-balance of swamps has been established along these lines of intensive study in other

countries*, and an adaptation of these methods would supply many tangible results.

On this subject, the 1960 Annual Report of the United States Lake States Forest Experiment Station (2) states,

> "Conflicts for the use of land and the water resource are developing. Yet one knows the value of these areas (swamps), as a source of ground-water recharge, or as a stabilizing influence on streamflow. Basic to an understanding of the local hydrology is a knowledge of bog hydrology".

The Manual of Hydrometeorological Observations in Swamplands†, issued by the U.S.S.R., confirms this opinion, by stating

> "The only means of solving these problems (the role of swamplands in the water-balance of a given region) is the establishment of hydrometeorological stations in swamplands, to observe all components of heat and water balance, under natural conditions".

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* Weitzman, Sidney, Watershed Management. 1960 Annual Report. Lake States Forest Experiment Station, U.S. Dept. of Agriculture, St. Paul, Minnesota.

† Manual of Hydrometeorological Observations in Swamplands, U.S.S.R. Hydrometeorological Service translated by Meteorological Branch, Canada Dept. of Transport, 1960.

# CHAPTER 7

## THE AUTHORITY AND A SOIL CONSERVATION PROGRAM

### 1. Land Use Programs of Other Authorities

There are 30 Conservation Authorities (as of March 1961) in Ontario. Most of them have to varying degrees promoted soil conservation and land use management. Their programs vary, of course, with the location of the Authority and with the urgency of such problems as flood control.

The paragraphs below summarize land use and forest conservation programs of Authorities in Ontario. This outline is presented here as a review of the possibilities rather than as a recommendation to the Otonabee Authority of other Authorities' programs.

#### (a) Farm Ponds

Fifteen Authorities have farm pond assistance programs. Through them they encourage the construction of ponds for conservation purposes on privately owned land.

Most Authorities provide technical assistance and advice on pond construction and location. This advice is available from Authority staff, or from the Department of Agriculture. One Authority retains the services of a professional engineer for pond surveys.

All Authorities with pond assistance programs have regulations to govern pond construction. These regulations cover minimum size, depth, fencing, etc.

Most Authorities give some financial assistance towards the building of ponds. Such assistance varies from a straight $50 per pond, to a sliding scale of subsidies based on pond capacity, with a maximum of $300 for a pond of over 3 acres.

#### (b) Tree Planting

Nineteen Authorities have active forestry programs. A number of Authorities own tree planters which are available for rent to private landowners. Several Authorities

also supply tractors and men to operate them. There is usually a charge for this service, often about one-half the actual cost.

(c) Authority Forests

Fourteen Authorities have established Authority Forests. They are established on marginal and sub-marginal land, Classes V, VI and VII; land that is usually unsuited to agriculture. Private landowners are often not in a position to return sub-marginal land to trees. Where reforestation is determined to be the most suitable use for such land, it can often be done best under public ownership.

(d) Grass Waterways

Several Authorities promote the construction of grass waterways on private land by offering financial assistance toward their construction. The amount of assistance varies, and may go as high as $150 per farm.

(e) Demonstrations

Several Authorities have used demonstrations as an effective means of illustrating the values of certain land-use practices. These demonstrations have been carried out in several ways. One method is to demonstrate a specific land-use improvement on privately owned land. This may be the building of a grass waterway, or a drainage project, or a farm pond. The landowner involved usually receives some financial assistance on the project in return for use of this land as a demonstration.

Several Authorities have purchased property for specific use as demonstration farms. The Grand Valley Conservation Authority owns a 50-acre farm in the lower end of the watershed near the town of Caledonia. On it they have carried out reforestation, pasture improvement, built a pond and constructed gully control works. The Saugeen Valley Authority purchased and operates a pasture demonstration farm. This farm is located on land in Grey County that tends towards the marginal for agriculture. Various soil management measures and seed mixtures are used and the intensity of grazing is controlled.

Most of the Authorities that have established "Conservation Areas" carry out land-use demonstrations on them. These demonstrations have value to both urban and rural visitors. Reforestation, pasture management, farm ponds, gully control and grass waterways are well known management practices that can be shown to visitors, and give Conservation Areas good reason to be called multiple purpose areas.

Demonstrations are carried on in co-operation with local farm organizations and the Department of Agriculture.

2. Land Use Program in the Otonabee Authority

Fertility, drainage and erosion, often in that order, are the main soil management problems facing landowners. It is essentially the responsibility of the landowner to recognize and overcome these problems on his own land. Soil reports, conservation reports, and other material is available to inform him, but he must see the problem in his own area, and know how to overcome it, or where to get assistance. His management practices will be guided by his interests, experience and by economic conditions.

An Authority can hope to carry out by itself only a small portion of the conservation work needed in a watershed. Any conservation program must first deal with people before it deals with land. Particularly is this true of soil conservation measures. An Authority can be most effective in a soil conservation program by interesting, informing and showing landowners the problems and the benefits of good soil management. To a small extent an Authority may also assist financially, e.g., by providing some financial aid in gully control or grass waterways.

The Department of Agriculture and the Ontario Agricultural College are primarily given the responsibility for advising farmers in soil problems. Their assistance is quite varied, ranging from soil test and fertilizer recommendations to lay-out of farm ponds and the planning of crop rotations. The Agricultural Representative, and the extension specialists in

soils, crops and engineering are available without cost to advise and assist farmers with their problems. It is by working with these specialists and with their departments that a Conservation Authority can be most effective in a land-use program.

A soil conservation program of an Authority should complement existing services. Demonstrations, projects, exhibits and tours can be worked out with the agriculturalists. An Authority can often provide them with facilities, and sometimes funds, not usually available to them. The Authority could, for example work out a soil management demonstration in a Conservation Area, with the Department of Agriculture providing land for this purpose that might not otherwise be available.

Limited financial assistance, when given to aid in the construction of farm ponds, or grass waterways or gully control, can often provide the incentive needed to persuade a landowner to undertake a recommended measure. An Authority can use its funds, staff and facilities for publicity and education on the benefits of good land management. Tours, exhibits, booklets and school projects can be worth-while parts of a soil conservation program.

An Authority's role in soil conservation is more that of co-operation, rather than initiation. When an Authority has an active overall conservation program, the soil and land-use portion of it may seem minor. Soil conservation is influenced, more than any other aspect of a conservation program, by factors outside the control and jurisdiction of the Authority. The purchase of land for forestry, or for recreation, or the building of structures for water control are Authority projects immediately recognizable. Improving the use and management of farm lands is essentially educational; it is long-range and it often seems very slow. Neverthless seemingly minor projects may have many long-range values.